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Engineering Library

BRITISH MACHINE TOOLS AT OLYMPIA.—Special Supplement.

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The Engineer

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The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES: DOUBLE CONTROL SLUICES. Tenders due on the 2nd October, 1924. Tender forms obtainable from above. 6896

Assistant Engineers (4) REQUIRED by the GOVERNMENT of the GOLD COAST for the PUBLIC WORKS DEPARTMENT for two tours of 12 to 18 months' service, with possible extension. Salary £480 for the first three years of service and then £510, rising to £730 a year by annual increments of £30, and thence to £920 by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passage and liberal leave on full salary. Candidates, aged 27 to 35, preferably single, should have had considerable experience on road and bridge work, including construction of reinforced concrete bridges and culverts, tar-macadam and tar-sprayed metalled roads. A.M.I.C.E. preferred, and should be able to ride a motor cycle.—Apply at once in writing, stating age and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/12,880. 6856

Civil Service Commission. FORTHCOMING EXAMINATION: PROBATIONARY ASSISTANT ENGINEER in the Engineering Department of the General Post Office (20-23, with extension in certain cases), 9th October. The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. 6880

Civil Service Commission. FORTHCOMING EXAMINATION: PROBATIONARY INSPECTORS in the Engineering Department of the General Post Office (17-20, with extension for service in H.M. Forces), 20th November. The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. 6885

Draughtsman Required by the GOVERNMENT of the GOLD COAST, for the PUBLIC WORKS DEPARTMENT, for two tours of 12 to 18 months' service, with possible extension. Salary £480 for the first three years of service and then £510, rising to £720 a year by annual increments of £30, and thence to £960 by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates should be between the age of 23 and 35 and Associates of the Royal Institute of British Architects.—Apply at once in writing, stating age and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/13,080. 6914

Technical Instructor Re- QUIRED for the Government Technical School, FEDERATED MALAY STATES, for 4 years' service. Salary 400 dollars a month, rising to 475 dollars by annual increments of 25 dollars a month, plus a strictly temporary cost of living allowance amounting to 10 per cent. of salary in the case of single men and 20 per cent. for married men. The Government rate of exchange is now 2s. 4d. to the dollar, but the purchasing power of the dollar in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. On the satisfactory termination of agreement a bonus of one month's salary will be paid. Free passages provided. Candidates, preferably single, aged 26 to 35, should have graduated at one of the Colleges granting a diploma or degree exempting the holder from passing sections (A) and (B) of the A.M.I.C.E. Examination, and should have had at least 2 years' experience as technical instructors. Must be competent to instruct junior officers or technical subordinates of the Public Works Department, Railways, Ports and Telegraphs and Survey Departments in the arts of:—

(A) Surveying, levelling, and the taking out of quantities.
(B) The drawing and preparation of plans and estimates.
(C) Organizing and controlling labour and the supervision of works under construction and expenditure thereon.
(D) Storekeeping and care of machinery and plant.

Apply at once by letter, stating age, whether married or single, and giving particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/13,002. 6901

Temporary Civil Engineer- ING ASSISTANTS REQUIRED for Government Department. Candidates must have served in H.M. Forces during the War and have had good training and experience in civil engineering and be capable of preparing designs and working drawings and making calculations required in connection with steel structures of large dimensions and ferro-concrete work, or, alternatively, have had experience in municipal or county engineers' offices and be fully competent to prepare designs, working drawings and specifications—under supervision—for drainage and sewage disposal works, water supply schemes, roads, and general civil engineering work. The normal inclusive maximum salary attached to these posts is £370 per annum, but salaries will be assessed according to qualifications and experience of candidates selected. Written applications with full details of experience, qualifications, age and salary required should be addressed to the JOINT SUBSTITUTION BOARD (Treasury and Ministry of Labour), Montagu House, Whitehall, S.W. 1. 6897

PUBLIC NOTICES

Admiralty. RATE FIXERS REQUIRED for technical cost staff in London, with long experience of fixing rates on machining, forging or foundry work, particularly two or more of the following types of work, viz., Guns, Gun Mountings, Gun Sights, Gun Hydraulic Gear, Aero Engines, Car Engines and Chassis. Salary £300 to £350 per annum unestablished, with prospect of subsequent promotion to established position carrying pension rights. Preference will be given to ex-Service men.—Apply by letter to C.E. BRANCH, Admiralty, S.W. 1. 6896

Cardiff Education Committee.

THE TECHNICAL COLLEGE.

Principal: CHARLES COLES, B.Sc. (Lond.)

DEPARTMENT OF ENGINEERING.

Head of Department: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1924-25
(Commencing on TUESDAY, 7th OCTOBER, 1924).

The following Courses have been arranged for Engineering Students:—

A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually and candidates for entry to the above Department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for Entrance Scholarship Examination, duly filled up, must be received before September 15th.

JOHN J. JACKSON, Director of Education, City Hall, Cardiff. 6770

County Borough of Croydon.

EDUCATION COMMITTEE.
CENTRAL POLYTECHNIC—MECHANICAL ENGINEERING DEPARTMENT.

There is a VACANCY for a TEACHER of ENGINEERING CALCULATIONS, to apprentice students for one evening per week. Salary 15s. per evening of two hours. Applications, giving full particulars of education, training, experience, present appointments, age, &c., to be sent to the Principal.

JAMES SMYTH,
Clerk to the Education Committee.
Education Office, Croydon. 6858

PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY, extending over either three or four years, are arranged in CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' Course provides, in addition to the academic training, opportunity for practical training in "Works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.
C. A. GENEVE, B.Sc., A.M.I. Mech. E., Senior Lecturer.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering (Dean).
C. H. LOBBAN, B.Sc., A.M. Inst. C.E., Senior Lecturer.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Lecturer.
Professor S. A. F. WHITE, M.A., Mathematics.
Professor A. E. TOLLIFFE, M.A., ditto.

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room, and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6831

University of the Witwaters- RAND, JOHANNESBURG.

CHAIR OF ELECTROTECHNICS.

APPLICATIONS are INVITED for the CHAIR of ELECTROTECHNICS, vacant through the retirement, under superannuation, of Professor H. J. S. Heather.

SALARY.—£1000 per annum, rising by annual increments of £50 to £1100.

TRANSPORT.—Allowance of £60 towards passage expenses together with free 1st class ticket from Cape Town to Johannesburg. Half salary during voyage.

CONDITIONS.—The appointment is full-time and subject to the regulations of the University. Duty is to be assumed on 1st March, 1925.

Applications, with copies of testimonials, all in quintuplicate, should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, W.C. 2 (from whom further particulars and forms of application may be obtained), not later than 30th September, 1924. 6880

PUBLIC NOTICES

ENGINEERING AND TECHNICAL OPTICS.

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.

ENGINEERING DAY COLLEGE.

Full-time Day Courses in the Theory and Practice of Civil, Mechanical, and Electrical Engineering. The Courses in Civil and Mechanical Engineering include specialisation in Automobile and AERONAUTICAL Engineering, and those in Electrical Engineering include specialisation in RADIO-TELEGRAPHY.

The ENTRANCE EXAMINATION will be held on TUESDAY and WEDNESDAY, 23rd and 24th SEPTEMBER. The Courses include periods spent in commercial workshops and extend over four years. They also prepare for the Degree of B.Sc. in Engineering at the University of London. Fees £18 and £13 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £82 each for the complete course will be offered for competition at the Entrance Examination.

OPTICAL ENGINEERING AND TECHNICAL OPTICS.

Full and Part-time Courses in this important department of Applied Science are given in specially equipped laboratories and lecture rooms. The Annual Entrance Examination is held in September.

All day courses commence on Monday, 29th September.

EVENING TECHNICAL COURSES in all branches of Mechanical and Electrical Engineering commence on Monday, September 22nd, 1924.

The Laboratories, both Mechanical and Electrical, are well equipped with modern apparatus, which, on the mechanical side, provides for specialisation in Automobile and Aeronautical Engineering and, on the electrical side, for specialisation in Alternate and Continuous-current Work, in Radio-telegraphy and Telephony, and in Electrical Testing.

More complete particulars, together with conditions of entrance, &c., and all information respecting the work of the Institute, can be obtained at the Institute or on application to

S. C. LAWS, M.A., M.Sc.,
6521 Principal.

The University of Sheffield.

SESSION 1924-25.

Vice-Chancellor: Sir HENRY HADOW, C.B.E., D. Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.

The LECTURE COURSES commence OCTOBER 1st, 1924.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 23rd, 1924.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS,
6712 Registrar.

FIRE APPLIANCES.

The Guardians of the Poor of the Parish of Lambeth are prepared to receive TENDERS for the SUPPLY and DELIVERY of COUPLING ADAPTORS, FIRE HOSE, HOSE COUPLINGS, GOOSENECKS, NOZZLES, SPANNERS, &c. Form of Tender and specification to be obtained from the CLERK to the GUARDIANS, Guardians' Offices, Brook-street, Kennington-road, S.E. 11. Tenders to be returned not later than Tuesday, the 16th September. 6855

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PUBLIC NOTICES

Newcastle-upon-Tyne Education Committee.

RUTHERFORD TECHNICAL COLLEGE.

Principal: C. L. ECLAIR-HEATH, Wh.Sc., A.M.I.M.E.

REQUIRED, as early as possible, LECTURER in ELECTRICAL ENGINEERING for senior work. Candidates should have had good drawing-office and works experience, have received a good technical education in a University or Technical College, and have obtained a University Degree or its equivalent. Teaching experience desirable.

Salary according to Burnham Technical Scale, less 5 per cent.

Applications (on forms to be obtained by sending stamped addressed foolscap envelope), to be returned to the undersigned not later than first post Tuesday 16th September, 1924.

THOS. WALLING,
Director of Education.

Education Office, Northumberland-road. 6832

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for:

(a) OPEN and COVERED GOODS BOGIE WAGONS and 4-WHEELED BRAKE VAN UNDERFRAMES, 2ft. 6in. gauge.

(b) 60ft. CARRIAGE UNDERFRAMES, 5ft. 6in. gauge.

(c) CARRIAGE UNDERFRAMES, 2ft. 6in. gauge.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 10th September, 1924.

A fee of 20s. will be charged for each specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 18th September, 1924, in the case of (a), and not later than Noon on Thursday, 25th September, 1924, in the case of (b) and (c).

The Directors do not bind themselves to accept the lowest or any Tender and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS,
Secretary.

6873

The Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for:—

AXLE-BOXES AND FITTINGS.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 5th September, 1924.

A fee of 10s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 18th September, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

6862

Bombay, Baroda, and Central India Railway Company.

ELECTRIFICATION OF BOMBAY SUBURBAN LINES.

The Directors are prepared to receive TENDERS for the SUPPLY of the following PLANT, namely:—

	Fee for Specification.
1. TRACK BONDS	£2 per copy.

Specifications and forms of Tender (which must be submitted in duplicate) may be obtained at this office on and after 22nd September, 1924, on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Bombay, Baroda and Central India Railway Company.

Tenders must be sealed and addressed to the undersigned, marked "Tender for Track Bonds," and delivered not later than Noon on Monday, the 13th October, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

The Consulting Engineers to whom application for any further technical information may be made are Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W. 1.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1.
11th September, 1924. 6911

Caledonian Collieries, Limited.

NEWCASTLE, NEW SOUTH WALES, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY and ERECTION on site of:—

TURBO-ALTERNATORS,
CONDENSERS, PUMPS,
BOILERS, PIPE WORK,
SUPERHEATERS, CHIMNEY,
FANS, SWITCHBOARDS,
TRANSFORMERS, &c.

Specification can be obtained from Howard Smith, Limited, 33, Cornhill, London, E.C. 3, on deposit of £1 1s., which will be returned on receipt of bona fide Tender. Additional copies, 5s. each, which charge will not be refunded.

Tenders, endorsed "Electric Power Plant," and addressed to HOWARD SMITH, Limited, Managing Agents, Caledonian Collieries, Limited, 35/45, Market-street, Melbourne, Australia, must be delivered before 5 p.m., 25th November, 1924. 6874

City and County of Newcastle-upon-Tyne.

COUNTY BOROUGH OF GATESHEAD.

PROPOSED NEW BRIDGE ACROSS THE RIVER TYNE.

The Corporations of Newcastle-upon-Tyne and Gateshead are prepared to receive the NAMES of FIRMS desirous of TENDERING for the ERECTION of a BRIDGE across the River Tyne, with approaches. Applications should be sent, before the 20th September, to the undersigned, accompanied by a statement of recent experience of similar work. From the list of names received a limited number will be selected who will be asked to tender for the work.

General information regarding the scheme may be obtained from Messrs. Mott, Hay and Anderson, 9, Iddesleigh House, Caxton-street, London, S.W. 1.

Applications will only be considered from firms who have had large bridge building experience.

Dated this 9th day of September, 1924.

A. M. OLIVER,
Town Clerk.

Newcastle-upon-Tyne. 6888

Farnham Urban District Council

WATERWORKS.

CONTRACT NO. 1.—DISTRIBUTING MAINS.

TO CONTRACTORS.

The Farnham Urban District Council are prepared to receive TENDERS for the PROVISION, LAYING, and JOINTING of about 2900 YARDS of 7in., 6in., and 5in. CAST IRON MAINS, together with VALVES and HYDRANTS, and MAKING CONNECTIONS to existing MAINS.

Contractors desirous of tendering may obtain a copy of the general conditions, specification, bill of quantities and form of Tender from the office of the Engineers, Messrs. John Taylor and Sons, 36, Victoria-street, Westminster, S.W. 1, on payment of £5 (cheque only), which will be returned on receipt of a bona fide Tender.

Drawings may be inspected either at the offices of the Engineer or at the Council Offices.

Tenders, endorsed "Tender for Mains," must be delivered in a sealed package, addressed to the Clerk to the Council, Council Offices, Farnham, Surrey, on or before Noon on Friday, the 26th day of September, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

(Sgd.) J. W. WRIGHT,
Clerk.

6857

LONDON COUNTY COUNCIL.

ENGINEERING

(AERONAUTICAL, CIVIL, ELECTRICAL, GAS, MARINE, MECHANICAL, MOTOR CAR, AND STRUCTURAL).

DAY AND EVENING CLASSES.

Battersea Polytechnic, Battersea Park Road, S.W. 11.	Full-time Day Courses in Mechanical Engineering Civil and Constructional Engineering, and Electrical Engineering. Evening Classes in Mechanical, Civil, and Electrical Engineering. Trade Classes (including Classes for Motor Drivers)
Borough Polytechnic, Borough Road, S.E. 1.	Day Technical School for Boys intending to enter the Engineering Trades. Evening Classes in Mechanical Engineering (including Motor Car Engineering); Electrical Engineering. Trade Classes.
Goldsmiths' College, New Cross, S.E. 14.	Evening Classes in Electrical, Mechanical, and Constructional Engineering. Trade Classes
Hackney Institute, Dalston Lane, E. 8	Day Technical School of Engineering. Evening Classes in Electrical, Mechanical, Motor Car, and Structural Engineering.
Northampton Polytechnic, St. John Street, Clerkenwell, E.C. 1.	Civil, Mechanical (including Aeronautical), and Electrical Engineering. Full-time Day School and Evening Classes. Day and Evening Courses in Optical Engineering, and Part-time Courses for Apprentices in the Electrical Trades.
Paddington Technical Institute, Saltram Crescent, W. 9.	Day Technical School of Engineering. Evening Classes in Electrical and Mechanical Engineering.
Regent Street Polytechnic, Regent Street, W. 1.	Civil, Electrical, Motor Car, and Mechanical Engineering. Day School and Evening Classes. Evening Classes in Aeronautical and Gas Engineering.
School of Engineering and Navigation, High Street, Poplar, E. 14.	Day Technical School of Engineering, with Department in Marine Engineering. Evening Classes in Electrical, Marine, and Mechanical Engineering.
Wandsworth Technical Institute, High Street, Wandsworth, S.W. 18.	Evening Classes in Mechanical Engineering.
Westminster Technical Institute, Vincent Square, S.W. 1.	Evening Classes in Civil and Gas Engineering.
Woolwich Polytechnic, William Street, Woolwich, S.E. 18.	Day School for Boys intending to enter the Engineering Trades. Part-time Day Courses for Engineer and Trade Apprentices. Evening Classes in Mechanical, Structural, and Electrical Engineering. Special Lectures in Motor Engineering Trade Classes.

Full particulars as to fees, &c., may be obtained on application at the various Institutions.
Evening Classes open 15th September, 1924.

JAMES BIRD,
Clerk of the London County Council.

PUBLIC NOTICES

County Borough of Warrington.

KNUTSFORD-ROAD IMPROVEMENTS—BLACK BEAR BRIDGE.

TENDERS are INVITED for the RECONSTRUCTION of the above BRIDGE in REINFORCED CONCRETE crossing the Bridgewater Canal in one span of 28ft., including the PROVISION of APPROACH RETAINING WALL, &c.

Drawings are prepared and can be seen after the 6th inst. at the office of the Engineer for the work, Mr. H. W. Fitzsimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster, S.W. 1. Copies of the specification, bill of quantities, and form of Tender are to be obtained from the Engineer's office on payment of Three Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Tenders are to be sent to the undersigned not later than Noon on Monday, 22nd day of September, and endorsed "Tender for Black Bear Bridge."

The Corporation do not undertake to accept either the lowest or any Tender.

By Order,
A. T. HALLAWAY,
Town Clerk.

Town Hall, Warrington. 6850

County Borough of Warrington.

KNUTSFORD-ROAD IMPROVEMENT—RETAINING WALL.

TENDERS are INVITED for the CONSTRUCTION of a PILED RETAINING WALL in REINFORCED CONCRETE about 700ft. long, alongside Knutsford-road and on the bank of the River Mersey.

Drawings are prepared and can be seen after the 6th inst. at the office of the Engineer for the work, Mr. H. W. Fitzsimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster, S.W. 1. Copies of the specification, bill of quantities, and form of Tender are to be obtained from the Engineer's office on payment of Three Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Tenders are to be sent to the undersigned not later than Noon on Monday, 22nd day of September, and endorsed "Tender for Retaining Wall."

The Corporation do not undertake to accept either the lowest or any Tender.

By Order,
A. T. HALLAWAY,
Town Clerk.

Town Hall, Warrington. 6851

State Electricity Commission OF VICTORIA.

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to

Agent-General for Victoria,
Melbourne-place, Strand, London, W.C. 2.

SPECIFICATION NO. 24/85.—66,000-VOLT TRANSFORMERS, INDUCTION REGULATORS AND ACCESSORIES.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on the prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 1st December, 1924.

R. LIDDELOW,
Secretary.

6779

PUBLIC NOTICES

State Electricity Commission OF VICTORIA.

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to:—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 24/90.—22,000-VOLT CABLE AND ACCESSORIES.

CHARGE.—£1 for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 24th November, 1924.

R. LIDDELOW,
Secretary.

6863

The South Indian Railway Company, Limited,

are prepared to receive TENDERS for the SUPPLY of:—

20 BOGIE OIL TANK WAGONS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Bogie Oil Tank Wagons," must be left with the undersigned not later than Twelve Noon on Friday, the 7th November, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Consulting Engineers to the Company, Messrs. Robert White and Partners, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1.
5th September, 1924. 6879

The South Indian Railway Company, Limited,

are prepared to receive TENDERS for the SUPPLY of:—

(1) STRUCTURAL STEEL WORK (Consumable Stores Sheds).

(2) STRUCTURAL STEEL WORK (Yard Plant).

(3) SCREWS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Structural Steel Work (Consumable Stores Sheds)," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 14th November, 1924, in respect of Specifications Nos. 1 and 2, and 26th September, 1924, in respect of Specification No. 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, and of 5s. for each copy of Specifications Nos. 2 and 3.

Copies of the drawings may be obtained at the offices of the Consulting Engineers to the Company, Messrs. Robert White and Partners, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1. 6910

PUBLIC NOTICES

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. TENDERS for the SUPPLY of:—

(1) WHEELS AND AXLES.

(2) BOGIE RAIL AND TIMBER TRUCKS,

for No. 1 on Wednesday, the 24th instant, and for No. 2 on Wednesday, the 1st October proximo.

Copies of the specifications can be obtained at the Company's offices on payment of £1 1s. each. This fee is not returnable.

G. E. LILLIE,
Secretary.

73-76, King William-street, London, E.C. 4.
11th September, 1924. 6912

Lambeth Workhouse, Prince's-road, Kennington, London

(Near Albert Embankment and Vauxhall Railway Station (Southern Railway).

This desirable FREEHOLD PROPERTY FOR DISPOSAL, 2 acres in extent, comprising substantial buildings containing approximately 51,250 super feet floor space and 928,249 cubic feet of buildings.

Frontages approximately:—

Prince's-road	410ft.
Tyers-street	290ft.
Vauxhall-street	266ft.

Apply, CLERK TO THE GUARDIANS, Guardians' Offices, Brook-street, Kennington, S.E. 11, to whom all inquiries should be addressed. 6913

Madras Port Trust.

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEER.

An ASSISTANT MECHANICAL and ELECTRICAL ENGINEER, who must have received a good general and technical education and should possess a Degree in Electrical Engineering from a recognised University, and also be an Associate Member by examination of the British Institute of Electrical Engineers, and who must have served an apprenticeship in the workshops and drawing-office of a firm of electrical engineers of standing for at least three years, is REQUIRED for service in India. Preference will be given to candidates who, in addition to the above, have had some experience of Locomotive and Marine Engineering. Age not over 30 years. Single men preferred.

SALARY.—Rs. 500, rising to Rs. 750 per calendar month, with free quarters or Rs. 60 house allowance in lieu thereof, plus advantages of Provident Fund and gratuity according to the rules in force.

Three years' agreement (subject to six months' probation) in the first instance.

First-class free passage out and home again, subject to satisfactory service.

Applicants must state whether they are married or single, and give a detailed record of their career in chronological order, with dates, giving names of firms where apprenticeship was served and subsequent experience, and reference must specially be made to each of the qualifications set out above, stating definitely whether such experience has been acquired or not.

Applications should be addressed to the undersigned, with copies only of testimonials, &c., not later than the 20th September, 1924.

RENDEL, PALMER and TRITTON,
Appointments Department,
12-14, Dartmouth-street,
6909 Westminster, S.W. 1.

Singapore, Straits Settlements.

WATER DEPARTMENT.

ASSISTANT ENGINEER.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT WATER ENGINEER, age 25-30, unmarried, on a four years' agreement, with possible extension. He must have had a good technical education, a regular training as a Civil Engineer, and have a practical knowledge of Surveying, Levelling, and Estimating, and at least three years' experience in works of Water Supply. Preference will be given to an assistant who has passed the examination of the Institution of Civil Engineers as Assoc. M. Inst. C.E. The Testamur by examination of the Institution of Municipal and County Engineers will be an advantage. Salary 6060 dollars for the first, 7440 dollars for the second, 7920 dollars for the third, and 8400 dollars for the fourth year, paid monthly in dollars, the currency of the Colony, the value of the dollar being two shillings and fourpence sterling. The pay of the appointment for the first year at this rate would be £812. Such local transport allowance as may from time to time be sanctioned by the Commissioners will be paid. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass a medical examination.

—Applications, stating whether married or single, age, and place of birth, and giving details of education, training, and experience, particularly in water-works, and referring to all the above requirements in detail, accompanied by copies (only) of testimonials, and also personal references, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 16th September, 1924. 6805

SITUATIONS OPEN

WANTED, Qualified GAS and MECHANICAL ENGINEER for Oil Works in Esthonia. Applicants must have had good experience in Gas Carbonising and By-product Work or Coke Oven and By-product Work, and to be capable of controlling men. The position would be a progressive one to the right man with the necessary abilities. A man having experience in shale oil production and distillation would be considered.—Write, stating age, salary, and experience, and when at liberty, to Box 853, Frost-Smith Advt. Service, 66, Finsbury Pavement, E.C. 2. P9521 A

WANTED, to REPRESENT British FIRM in India, fully qualified ENGINEER of good education and address. Preferably with knowledge of Ball and Roller Bearing applications and experience of salesmanship. Single man preferred.—Write, stating salary required, Box M395, Willings, 30, King-street, Covent Garden, W.C. 2. 6848 A

AIRCRAFT RATE FIXERS REQUIRED by Aircraft Firm in London district. One used to General Woodwork, detail and assembly, and one for Metal Work, detail and assembly. Only fully qualified men need apply. State age, salary required, and full particulars of past experience.—Address, 6890, The Engineer Office. 6890 A

ENGINEER. — REPRESENTATIVE WANTED, in London; Cranes, Aerial Ropeways, Handling Plant. Chief qualification the getting of orders. Applications treated in confidence.—Address, stating experience, salary expected, 6833, The Engineer Office. 6833 A

ENGINEER REQUIRED, Must be Thoroughly experienced in designing Aerial Ropeways. Salary £750 per annum.—Address full details, experience, age, &c., 6859, The Engineer Office. 6859 A

THE SERVICES of a Competent ENGINEER are REQUIRED by old-established Manufacturers of High-speed Reciprocating Steam Engines, to Design and Assist in Developing the Manufacture of Steam Turbines. The modern works are properly equipped for manufacturing and testing electric generating combined plants.—Address, stating age, experience, qualifications, and salary required, 6820, The Engineer Office. 6820 A

WORKS ENGINEER WANTED for Electrical Manufacturers, S.W. District, employing 250 hands. Drawing-office experience essential, able to take full charge of Machine Shop, Mechanical and Electrical Installation and Repair Work.—Address, giving full particulars, 6891, The Engineer Office. 6891 A

WORKS SUPERINTENDENT for Electrical Measuring Instruments Factory. Up-to-date manufacturing experience essential.—State experience and salary to EVERETT, EDGCUMBE and CO., Ltd., Hendon, N.W. 9. 6804 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Waterloo Temporary Bridge.

PREPARATORY work has been begun with the view to the later erection of the temporary wooden bridge which is to take the place of Waterloo Bridge during the period of its reconstruction. The temporary structure will be built a few feet to the east of the main bridge, and it will be slightly curved at either end in order to allow it to merge into the present bridge approaches. As the final design of the temporary bridge depends to some extent on the decision as to whether the present bridge is to be widened or reconstructed, complete details regarding it cannot be yet given. We understand, however, that it is intended to provide a carriageway 20ft. wide. This width, although less than that of Waterloo Bridge by some 7½ft., will permit of a single line of traffic each way. It is expected that a speed limit and also a weight restriction will have to be imposed on all traffic using the temporary structure. In all probability the temporary bridge, which is to be constructed by Sir William Arrol and Co., Limited, will be completed towards the end of next summer, but two to three years may be required to rebuild the present bridge and make the modifications required.

The New Cunard Liner Aurania.

AFTER undergoing successful trials, the new Cunard liner Aurania left the Tyne on Saturday for Liverpool, from which port she sails to-morrow on her maiden voyage to New York. The new Aurania is the third ship of that name in the company's service, and she is one of five intermediate liners ordered since the war. She is a single-funnelled vessel of handsome appearance, with about 15,000 tons gross tonnage. Her length is 538ft. with a breadth of 65ft. and a depth to shelter deck of 43ft. The passenger accommodation embodies all the newest improvements and provision is made for 1568 persons, of whom 434 will be first-class passengers. It is of interest to note that the Aurania, which was built by Swan, Hunter and Wigham Richardson, Limited, at Wallsend, was launched from the berth on which the Mauretania was built close upon seventeen years ago. The propelling machinery, which is designed for a speed of 16 knots, was built by the Wallsend Slipway and Engineering Company, Limited, and it comprises two sets of Parsons turbines with double reduction gearing. Boilers equipped with Wallsend-Howden oil burners are fitted and they are so designed that they are capable of burning either oil or coal. A sister ship, the Ascania, is now approaching completion at the Walker yard of Sir W. G. Armstrong, Whitworth and Co., Limited.

The Inventor of Portland Cement.

ON Saturday last there was unveiled at Leeds Town Hall a bronze tablet commemorating the centenary of the date—October 21st, 1824—on which Joseph Aspdin, a stonemason of Leeds, patented Portland cement. This tablet is the gift of the American Portland Cement Association, representatives of which Association, together with members of the British Cement Makers' Federation, were present. Mr. F. W. Kelley, president of the American Association, performed the unveiling ceremony, and the memorial was accepted in the name of the city of Leeds by Sir Edwin Airey, the Lord Mayor of the city. It is interesting to note that Joseph Aspdin named his new production Portland cement from the likeness of the first concrete block to Portland stone. The factory where Aspdin secretly carried on the manufacture of Portland cement was surrounded with a 20ft. wall, and few of those employed in it knew apparently of the great importance of the discovery which had been made. From all accounts the inventor himself knew little chemistry, and most probably the discovery was accidental rather than the outcome of experiment and research. Mr. F. W. Kelley stated it was estimated that over 50,000,000 tons of Portland cement were used throughout the world in 1923, and that there was every prospect that both the demand for and the supply of cement would continue to increase as the value of concrete became more appreciated by the peoples of the world. At the conclusion of the ceremony Sir Edwin Airey expressed his determination that in the near future a Chair of Cement Engineering should be founded in the University of Leeds.

New House-building Methods.

CONSIDERABLE interest has been displayed in the possibility of the employment of steel, iron and materials other than brick, in order to accelerate the rapid building of dwelling-houses. Two of the new proposals are schemes associated with the names of Commander Burney and Lord Weir for the construction of standard steel houses, while a Rotherham iron-founder proposes to built houses with standard cast iron plates. In response to a motion passed in the House of Lords, urging an inquiry into such methods, the Minister of Health has set up a Departmental Committee to investigate and to report on the subject. The terms of reference empower the Committee to inquire as to how the materials which are or may be available for the building of houses for the working classes, and to make recommendations as to that organisation which might be required to secure the adoption and use of approved new materials and methods by the local authorities or other persons building houses.

Accidents in the Royal Air Force.

AN announcement has been made by the Air Ministry with a view to correcting any misconceptions which it is thought might have arisen in connection with some recently published figures relating to flying accidents in the Royal Air Force. It is pointed out that a comparison of the actual number of accidents which have taken place during each of the last three years takes no account of the large increase in the size of the Air Force during this period and the much greater amount of flying which has taken place in the units. From July, 1921, to July, 1924, the number of squadrons was increased from thirty-four to forty-eight, and the average flying time per pilot was raised by nearly 100 per cent. In addition to this a larger number of pilots than those required for forty-eight squadrons is now undergoing training, with a consequent material increase in the current volume of flying. Taking these facts into consideration, it is shown that, although the number of accidents in the present year exceeds those over corresponding periods for 1922 and 1923, there has, none the less, been a continuous improvement during the last two years in the ratio of hours flown to the number of fatal accidents. The returns show an increase of 47½ per cent. in the number of hours flown for one fatal accident for the twelve months ending June 30th, 1923, compared with the twelve months ending June 30th, 1922. During the same period ending June 30th, 1924, a further increase of 7½ per cent. in the number of hours flown for each fatal accident has been recorded. The announcement refers to the necessity of comprehensive training and frequent practice if high efficiency and safety is to be maintained. It is pointed out that the Royal Air Force is gradually being re-equipped with machines of new design, but that there is no ground for suggesting that any of the older designs still in use are in any way unsafe or are lacking in air worthiness. In the case of an accident of any kind a very complete investigation is made and a report forwarded to the Air Ministry with a view to eliminating such occurrences.

America's Trans-Atlantic Zeppelin.

THE new American airship ZA 3, which has just been completed at the works of the Zeppelin Company at Friedrichshafen, left her hangar early on Saturday morning last for a trial trip over South Germany with eighty passengers. The route taken embraced the towns of Munich, Nuremberg and Stuttgart, and an excellent run was made, the airship returning to Friedrichshafen at 5.50 p.m. after a flight of eight hours and forty minutes. A further 36 hours' voyage over Berlin to Scandinavia has been planned to take place during the present week, after which the airship will start for America. The date of her maiden voyage to New York has not, however, been yet fixed. The ZA 3 is the one hundred and twenty-sixth airship built by the Zeppelin Company, and she has a gas capacity of just under two and a-half million cubic feet, or about half that of the two airships which are to be built under the British Government scheme. The new American airship is propelled by five 400 brake horse-power Maybach reversible airship motors of special design. The cylinders are placed in vee form, two groups of six being employed on each engine, and the running speed is 1400 revolutions per minute. During the trial run a ships speed of 70 miles per hour is stated to have been maintained. Complete details of this new airship were published in the issue of THE ENGINEER for December 7th last.

The Proposed Tyne Bridge.

IT is now very nearly seven months since the Joint Committee, set up by the Corporation of Newcastle and Gateshead, confirmed the proposals, previously made, for the construction of a new bridge across the Tyne, and in the interval considerable progress has been made with the preliminary arrangements. The necessary Act of Parliament authorising the construction of the bridge has been obtained, and last week the consulting engineers were appointed. Sir Maurice Fitzmaurice and Mr. Basil Mott are to act not only for the bridge itself, but also for the associated works in general. It is noteworthy that the securing of the Act alone involved a large amount of negotiation, as the scheme was opposed by several bodies, although it is admitted on all hands a new bridge is a public necessity. The chief opposition came from the London and North-Eastern Railway on account of the probable diversion of traffic from the old High Level Bridge and the consequent loss of tolls. The Council has, however, made an arrangement with the company which, it is believed, will result in a gain to the ratepayers, as the traffic between the east sides of the two towns is expected to develop to such an extent that the tramway fares over the new bridge will provide a surplus revenue sufficient to indemnify the railway company. Although this scheme is progressing so satisfactorily it is now stated that the parallel proposal for a bridge at St. Anthony's will not be proceeded with this year.

The Value of Libraries and Records.

THE need of placing at the service of those engaged in industry and commerce a vast mass of information which should assist in the efficient conduct of business enterprises led to the holding of a conference on the subject, which took place last week-end at High Leigh, Hoddesdon. Dr. R. S. Hutton, of the British Non-ferrous Metals Research Association, and Mr. J. G. Pearce, of the British Cast Iron Research Association, who took a leading part in organising this first conference on the functions of special libraries and bureaux of information, secured a representative attendance. The list of delegates included not only those in charge of special libraries at the Patent Office, Science Museum, London School of Economics, and great public libraries, but research workers, those responsible for intelligence departments in important industrial undertakings, but representatives of many branches of the engineering and other trades who were frankly in search of knowledge on the subject. The programme covered a wide range, but the broad effect of a series of interesting discussions was to reveal the general weakness of the position and the lack in a majority of instances in most countries of a system of organised information which is now regarded as essential to success in business. Although no definite step was taken at the conference, a suggestion for the formation of an association of library users was put forward. A demand was made for the establishment of duplicate patent libraries in the great centres of industry and for a reduction in the price of Government publications.

The Ballybunion Mono-railway.

THE announcement that the mono-railway between Ballybunion and Listowell is to be demolished revives memories of an enterprise that no country but Ireland could have tolerated for more than a few weeks. A full description of the line and of its engines and rolling stock may be found in our issue of March 2nd and 9th, 1888. It was about 10 miles long and was constructed on the Lartigue mono-rail system. That system like nearly all its predecessors and successors, required in fact three rails, one to carry the coaches on the top of trestles and one at each side to prevent them from swinging. Three little locomotives were built for the railway by the Hunslet Engine Company. They weighed about 6½ tons apiece and each had two locomotive type boilers, one on each side of the carrying rail. The passenger rolling stock consisted originally of three first-class and four third-class coaches about 16ft. long by 8ft. wide. From the first the railway was far from a success, and the dreams of high speed were never realised. It ran with a happy disregard for punctuality and with a bumpiness and noisiness that excited the risibility of visitors, but somehow or other—probably, as its countrymen would say, "By the will of God"—it has kept on puffing on its ricketty course for thirty-six years. We trust that some part of it with an engine and rolling stock may be preserved.

The Explosion on s.s. Engadine.

THE triple-screw turbine steamer Engadine plys between Folkestone and Boulogne or Calais and Dover. On April 11th last, when fifty minutes out from Folkestone, a tube in one of the Babcock boilers with which she is fitted burst, causing the death of three men by scalding. A formal investigation into the cause of the accident was instituted by the Board of Trade, and owing to the conflict of evidence occupied no less than nine days. A report of the inquiry has just been issued. From it we learn that the explosion is attributed to lack of water caused by the neglect of a member of the engine-room staff to open a feed check valve. It appears that five of the six boilers which supply the turbines with steam were full up to three-quarter gauge glass on the evening preceding the accident, the sixth boiler being laid off for cleaning. The boilers are fed through a float feed tank provided with an indicator which can be seen from the manœuvring platform. After starting the chief engineer noticed that the water was rising in this tank and suspected that something was wrong. He instructed the second engineer to test the feed-water from the feed pumps for salt, and being satisfied on that point sent him to see if the check valves were working. Before the second engineer could report the accident occurred. The chief engineer had satisfied himself that all the check valves were operative at 9.10 a.m., but the Commissioners come to the conclusion that for some reason not ascertained a greaser had improperly closed that on No. 4 boiler before half-past ten. The chief blame for the accident is laid upon the third engineer, whose duty it was to make sure that the check valves were open and who should have seen from the state of the gauge glass that the boiler was short of water.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXI.*

GENERAL ENGINEERING EXHIBITS.

BELLISS AND MORCOM, LIMITED.

FOR upwards of twenty years Belliss and Morcom, Limited, of Ledsam-street Works, Birmingham, have constructed steam turbines of the impulse type, the first experimental machine having been built by them in 1904. The turbo-alternator shown by the firm at Wembley in conjunction with the Lancashire Dynamo and Motor Company, Limited, has a high-pressure turbine designed for an output of 1500 kilowatts when supplied with steam at 200 lb. per square inch pressure with any degree of superheat up to 650 deg. Fah. and a vacuum of 28½in. The alternator is constructed for producing 50-cycle three-phase current at 3300 volts pressure.

A general section through the turbine is given in Fig. 413, which serves to indicate the main features of the design, several of which are original. It will be noted that the governor and emergency mechanism with its oil-operated relays are contained in one circular casing at the end of the turbine, so that by removing an end cover all parts are immediately visible for inspection. The oil pump is placed in a sump in the bed-plate directly under the governor chamber, so that the relay cylinders can be fed with oil at 40 lb. pressure without the intervention of loose connecting pipes. The pump also supplies lubricating oil under pressure to all bearings. A hand pump for starting up is also fitted. The governor and emergency valve gears are, as noted, seen in Fig. 413, but are more clearly illustrated in Fig. 414. In this end view of the turbine the steam inlet chamber and valve chest with the emergency controls, including the automatic tripping and resetting gear, can be seen.

A section through the combined governor and emergency valves is given in Fig. 416. After passing through the stop valve and steam strainer the steam enters the emergency valve body, which in turbines up to 4000 kilowatts capacity, is constructed so as to be in the same casing as the governor controlled steam valve. The emergency valve is of the contracted throat or Venturi type and the valve seating is a steel casting of robust design. The valve itself is a mild steel forging and its shape is not unlike a pegtop with guiding spindles at either end, provision being made for the forked lever of the emergency trip gear. Both the valve and its seat are so constructed as to withstand heavy shock, and although no dashpot is used this valve, we are informed, may be closed within a fraction of a second without any chattering or fluttering and without sustaining any damage. The lines of flow and progression of area through the various sections of the valve are so arranged that the coefficient of discharge as referred to the diameter of the main steam pipe is unity. The emergency valve is operated by the unbalanced ring shown in Fig. 417. The outer rotating element has an unbalanced characteristic and at overspeed it is thrown out of centre and remains in that position until the speed of the turbine is substantially lowered. When in the out position it trips a lever which is directly attached to the oil relay cylinder and closes the emergency control valve. The gear, which is automatically tripped by the loss of oil pressure, may also be hand operated by the outside lever at the side of the valve box which is shown in Fig. 414. An outside resetting device is also provided. The governor valve shown to the right of Fig. 416 acts on the simple throttle system and is also controlled by link gear attached to an oil-operated relay. It has been very carefully designed, and a feature of the valve is, we learn, its positive closing tendency under steam and its non-kicking characteristic. Indeed, the valve we are describing is stated by the makers to be capable of being moved steadily by hand with comparative ease when under the full steam pressure.

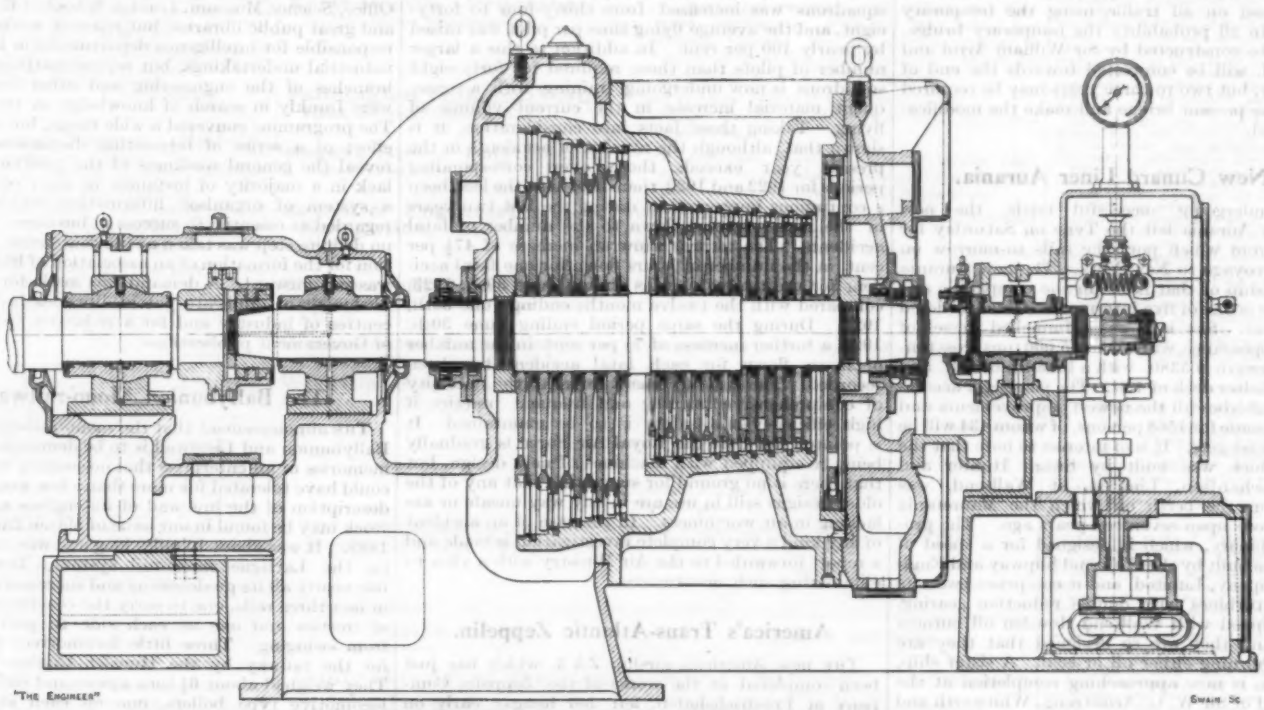


FIG. 413—1500-KILOWATT HIGH-PRESSURE TURBINE—BELLISS AND MORCOM

The main steam chest of the turbine occupies the bottom half of the high-pressure turbine casing only, and thus a high-pressure steam joint on the main horizontal joint of the turbine is avoided. The makers claim that this design serves to keep the heat losses small, with the very slight disadvantage of having the high-pressure nozzles on the bottom half of the casing only.

The high-pressure wheels are sometimes made of the two-stage Curtis type, but the makers prefer to use, wherever circumstances allow, single-row or Rateau type wheels. Some of the wheels are shown in Fig. 415, which also serves to illustrate the outside pressure gauges which are fitted to all bearings and to the gland-sealing steam connections. At the side of the valve chest the drain control valve wheels will also be seen. Reference may be made perhaps to the method of testing the material for turbine wheels which has been adopted by Belliss and Morcom, Limited. In addition to taking ordinary test bars from the blank of wheel material, it is customary to turn off a complete ring of material from the rim of

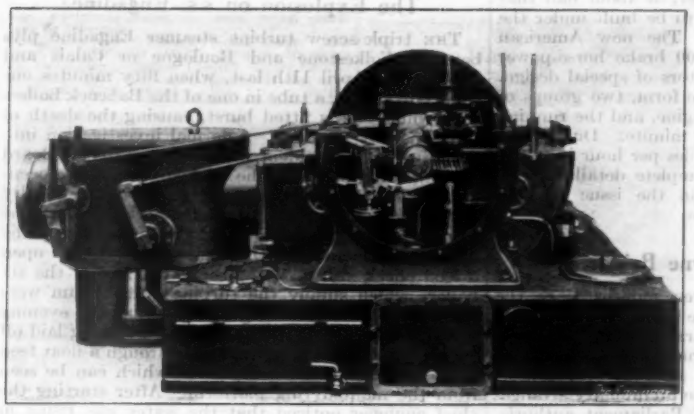


FIG. 414—END VIEW SHOWING GOVERNOR GEAR—BELLISS AND MORCOM

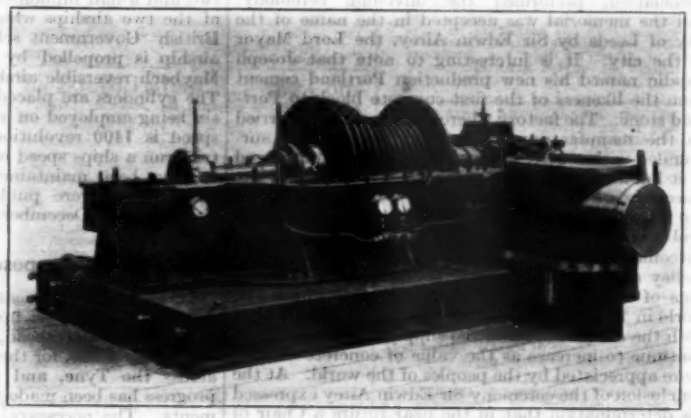


FIG. 415—TURBINE WITH UPPER CASING REMOVED—BELLISS AND MORCOM

* No. XX. appeared September 5th, 1924.

each wheel with the object of proving its soundness. This test ring is usually about ¼in. square, and if there are any radial cracks in the material which have been otherwise undetected, their presence is made known by the test ring, which will fall apart should such cracks be present. A further test for the toughness of the material is to cut the ring and to coil it up on an inch mandrel in the form of an helical spring. These tests ensure soundness of material for the wheels of the turbine. The diaphragms are made from rolled steel plates which are first machined all over, and the windows for the steamways are then cut out by an

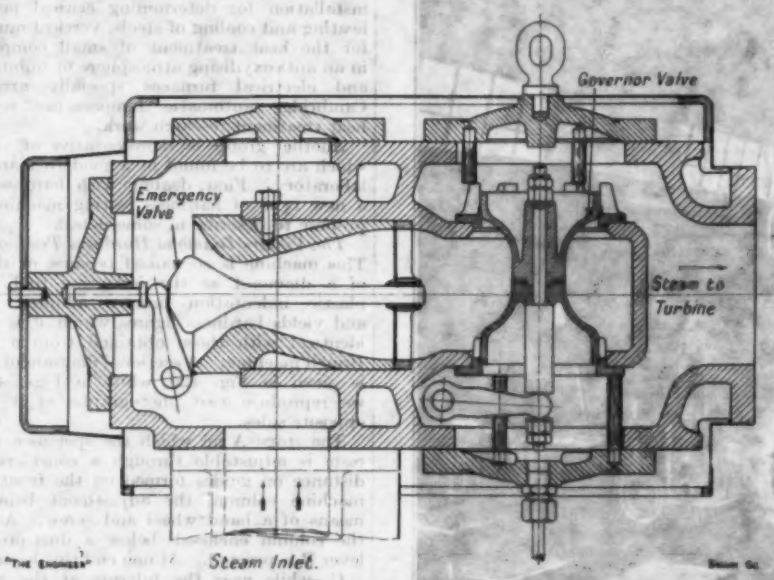


FIG. 416—SECTION THROUGH EMERGENCY AND GOVERNOR VALVES—BELLIS AND MORCOM

acetylene cutting machine. The machine enables the sectors to be removed to be cut clean and smooth, after which the spokes which remain are machined to an oval stream line shape. The nozzle blading is not cast in the diaphragm, but the blade segments are clipped on to it by means of their shrouds and are consequently easily removed for the purpose of cleaning. This form of construction has moreover the advantage that blading can be made of any desired metal, such as steel, monel, or brass. With the exception of the first few rows, "Standard" brass blading made from drawn strip has been found to be most successful. The makers find that a more efficient section of nozzle passage can be obtained by using sheet metal blading. Diaphragms made in the manner described have been found to be superior to the cast iron cast-in blade type and no dishings or collapses have occurred.

Generally speaking, the wheels are massive in construction and are so proportioned that strength is retained while conditions which would give rise to shaft whipping are avoided, and provision is made for a fundamental fluttering periodicity well above the working speed of the machinery.

Each of the wheels is separately balanced, and the

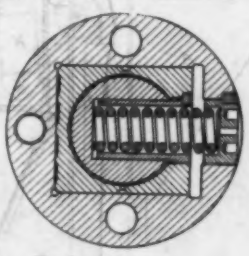


FIG. 417

first and last wheels are furnished with balancing grooves to allow for the subsequent elimination of any couple which might arise from later repairs. The moving blades used by the firm do not follow one stereotyped pattern either as regards the metal from which they are made or the method employed for attaching them to the wheels. The different methods of attachment are adapted with a view to the best service and to a minimum cost for repairs.

For the highly stressed moving blades, manganese bronze, mild or stainless steel are alike employed, and the blade and root are cut from the bar and formed in one piece. The tee head is so dimensioned that the blade may be slipped in sideways and turned round to fit in the grooves on the wheel rim. All blades are put in at the place they are finally to occupy and they are not driven round the groove from a gateway, and are not therefore slackened in that process. For the medium stressed blading, drawn strip blades are used with a pressed-out latch, which engages with a shoulder on a separate distance piece. For the low pressure blades drawn strip blading with bifurcated fangs is employed and accurately perforated bottom shrouding is used to maintain on even pitch. The bifurcated fang of the blade is opened by driving it on to a round wire laid at the bottom of a dovetail-shaped groove in the rim of the wheel. Turning to the main bearings of the turbine, it may be noted from Fig. 413 that the bearing shells are mounted in adjustable plummer blocks with large flat bottoms giving rigid support. Each bearing is provided with a brass safety ring at the point where the oil enters the bearing, and this ring assists in maintaining the level of the rotor shaft in the rare case of the bearing metal running out, and at the same time it tends to prevent the oil-way from becoming choked with metal.

Reference may be made in conclusion to the flexible type of bearing used to couple the turbine and alternator. One advantage claimed for the new construction exhibited is the absence of any heavy part which might, when worn, take up an eccentric position. In the new design of flexible coupling the torque of the shaft is transmitted through bundles of flat springs which are inserted endwise into the coupling. They are so placed that they are closely interlocked and yet may be slipped out and in quite easily. The whole system is lubricated from within the coupling by a connection taken from the 40 lb. oil pressure main distributor. A feature of the design is the ease with which the coupling may be disconnected for running the turbine alone. Although it is always desirable that shafts connected by a flexible coupling should be accurately aligned, the coupling we have described is so made that large errors in alignment can be accommodated without any undesirable results. Apart from the main turbine and alternator, several examples of diaphragm and blade construction are exhibited on the stand and serve to illustrate the different designs of blading which are used to meet varying conditions of service.

FIG. 418—THE VICKERS RESEARCH LABORATORY AT WEMBLEY

VICKERS, LIMITED.

Among the exhibits of the large engineering and shipbuilding firms at Wembley few are more outstanding in interest than that which is devoted to the products of Vickers, Limited, and its associated companies. The Vickers stand is remarkable not alone for the wide range of co-ordinated interests which it represents, but also for the excellent and harmonious way in which the various exhibits are presented. The name of Vickers is inseparable from that firm's great achievements in naval construction and the manufacture of armaments, and even at a time when orders for naval work have fallen to a fractional percentage of pre-war activities the visitor to Wembley will find striking evidence of the leading position the firm holds with regard to naval and military engineering.

General Exhibits.—We may, perhaps, refer briefly to the chief exhibits contributed by the various departments of the Vickers organisation. The most prominent exhibit on the Ordnance Department's section of the stand is a full-scale model of a 16in. naval gun with an actual complete breech mechanism of improved design which is shown in operation. Other examples of ordnance include howitzers, field guns, anti-aircraft guns, and machine guns of various types. A showcase of sporting guns and rifles made at the Crayford works is also displayed. The Naval Construction Works at Barrow has contributed models of submarines of the "E," "K" and "M" classes, and also a model of a monitor. Other models of Vickers' ships which are shown are the Japanese battle cruiser Kongo and the Brazilian battleship Sao Paulo, which is placed within a model of the 22,000-ton floating dry dock which was supplied by Vickers for this ship.

The more recent mercantile developments at the Barrow works are illustrated by a model of the 20,000-ton Orient liner Orama, which is now approaching completion and is expected to start on her maiden voyage to Australia on November 15th. The Vickers-Wingate system of double bottom construction is well shown by a model of the Donaldson motor ship Moveria. This system is claimed to give excellent access for repairs both to the hull and the various pipe connections, while a reduction of weight and saving in cost is, we are informed, also introduced.

The machinery exhibits from the Barrow works include, on the marine side, examples of main reduction gear wheels for steam turbines, engine and boiler auxiliaries and deck machinery. Other branches of this same works contribute a 420-ton electric winder, an unbreakable all-steel winding drum, while other mining exhibits comprise gyratory crushers, and a complete oil well-drilling plant, which is erected at a different part of the Exhibition. We noted with interest a new high-speed "Pavic" pump for viscous fluids and examples of the Vickeen oil separator. The aviation department of the firm is represented by a comprehensive display of Vickers aeroplanes, and models showing petrol accessories and method of the rod and wire construction.

The Sheffield steel works also display a very wide range of large and small forgings and pressings as well as motor car chassis parts and springs of various patterns. The Erith box-making department is represented by a complete installation of machinery used for box manufacturing, while this same depart

ment shows a roadside petrol pump of a new type. Reference must be made to the machine tool and small tool exhibits, which includes a No. 3 Vickers broaching machine, a tool-room lathe and a gear shaping machine. Small tools of every kind are displayed on this section of the stand, and means are provided for testing their special qualities. Turning to the group of firms associated with Vickers we single out a most attractive example of British

FIG. 419—THE VICKERS RESEARCH LABORATORY AT WEMBLEY

rolling stock construction, a new state saloon, which has been designed by the Metropolitan Carriage, Wagon and Finance Company for H.M. King Faud of Egypt. Another of the same firm's productions is half a rail coach and brake van, equipped for 1500-volt working. The object of showing this coach is to make clear the way in which standard main line rolling stock can be converted for electric working. Various systems of Vickers electric train lighting are also shown by the Train Lighting Department. Docker Bros., Limited, show various examples of paints and enamels, while axles and tires are exhibited by Taylor Bros., of Manchester, both of which firms are associated with Vickers, Limited.

Although we have not dealt in any complete way with all the various sections of this, one of the largest stands in the Exhibition, we have indicated the wide scope of the various industries represented. In such an organisation there is urgent need to keep a watchful eye on manufacturing processes, and the quality of both the manufactured and delivered materials. It is also of first importance to try out and evaluate new inventions and to carry on scientific research. The needs we have outlined have been partly met by the creation of a Central Research Laboratory at Dartford, which works in conjunction with the specialised laboratories of the various departments and factories.

The Vickers Research Building.—In the following section of this article we shall devote ourselves to describing the Vickers Research Building, which is probably one of the most original exhibits in the Palace of Engineering, views of the interior of the building are given in Figs. 418 and 419. It has an area of scarcely over 2000 square feet, but it is well equipped with apparatus, and permits the visitor to obtain some idea of the vast research undertaking which is so intimately concerned with the various Vickers factories. Naturally it is not possible to describe in detail the specialised research work which is carried on at nearly all the important works of the company; but we hope that a clear idea will be given of the twofold part played by research in the control of various works processes, in the elucidation of problems, which may affect any particular branch of works production, or again in the discovery of a new method of manufacture, a new material, or in prosecuting the work of pure, rather than applied science.

The apparatus shown rightly excludes, we think, the more or less familiar equipment of the physical or chemical laboratory.

The space on the ground floor is devoted to apparatus connected with the investigation of a particular problem, namely, that of the low-temperature distillation of coals, lignites, carbonaceous shales on an experimental scale. Here too instruments connected with the manufacture of electrical machinery and small apparatus, such as magnetos are shown, and examples of apparatus used in the controlling of the manufacture of steel and non-ferrous metals are to be seen, while lastly a series of perhaps lesser known instruments serve to illustrate the type of work which is being done at the Central Research Laboratory at Dartford.

Having outlined the groups into which the laboratory is divided, some description may be given of the individual apparatus. It may be stated that a staff of four or five scientific workers from the various laboratories of the firm are in attendance at the Research Building, and we found them all well qualified to answer any question in relation to the apparatus and the various uses to which it is put.

We have referred to the experimental apparatus for low-temperature distillation tests. This takes the form of a complete working model of a Vickers "Fusion" rotary retort, manufactured by the Fusion Corporation, Limited, Middlewich, Cheshire, under Hutchins' patents and shown by the Central Experimental Research Department. The apparatus, which was described in detail in THE ENGINEER of January 5th, 1923, consists essentially of a long horizontal externally-heated tube retort, with a positive feeding device at one end. The tube chamber is heated by producer gas, and an internal temperature of 200 to 400 deg. Cent. can be maintained. As the material passes through the retort it is prevented from caking on the walls of the retort by cast iron breakers of ingenious design. These tumblers are carried up the side of the slowly revolving tube, and by falling to the lowest position, any sticking or caking of the retort contents is prevented. At the outer end of the tube a reinforced asbestos ring is used to form a running joint between the tube, and its support. This ring is clamped to an inner flange of a corrugated diaphragm, which allows for expansion taking place. A complete model of a carbonising plant and oil refinery is also shown, as well as a wide range of representative low-temperature distillation products, which have been prepared in the laboratory of the Oil Engineering Department.

An interesting piece of testing apparatus from the research laboratory of the Metropolitan Vickers Electric Company, Limited, is that which is used for analysing the frequency of notes which are emitted by high-speed machinery, such as turbines and alternators. The principle employed is to compare the source of noise with the sound emitted by an oscillating thermionic valve, which may be electrically controlled to give a note of any frequency. Another exhibit from the same laboratory is an equipment for the electro-chemical analysis of non-ferrous metals by deposition. In this little machine a cathode of platinum gauze is made to revolve inside a fixed anode, and both are immersed in the solution to be tested. Provision is made for varying the voltage and the current density within the required limits, and plans have been worked out, we understand, for the electro-chemical estimation of nearly every type of non-ferrous metal by the deposition method. Another group of apparatus illustrates some special devices which have been evolved for controlling the manufacture of magnetos in the research laboratory of the British Lighting and Ignition Company, Limited. The tests made include capacity and leakage tests, and a rotating spark gap is used to ascertain the causes of "missing"; the checking of the strength and permanency of permanent magnets and the electrical properties of insulating material are also studied. In the apparatus for magneto leakage tests a variable high resistance is placed in parallel with the spark gap, which is in effect equal to a fault in the plug. The resistance is then adjusted till the spark just misses, when it is possible to evaluate the conductivity by means of a megger. A reading taken thus gives a direct indication of the capability of the magnets to give a spark under adverse conditions.

Turning now to the section dealing with the control of the manufacture of steel and non-ferrous alloys, as carried out at Vickers' Sheffield, Barrow, Erith, and other works, we may mention some of the furnace exhibits. They comprise a Callender recording installation for determining critical points in the heating and cooling of steels, vertical muffle furnaces for the heat treatment of small component parts in an anti-oxydising atmosphere of unburnt coal gas, and electrical furnaces specially arranged with Cambridge automatic temperature recorders for heat treatment research work.

Another group is representative of the machines which are to be found in a modern material testing laboratory. First, dealing with hardness we noted a new type of hardness testing machine which we propose to describe in some detail.

The Vickers Diamond Hardness Testing Machine.—This machine is so named because of the use made of a diamond as the indenting tool, follows the plastic indentation process adopted by Brinell, and yields hardness figures which, it is claimed, are identical with those obtained from a trustworthy Brinell machine. A sectional diagram of the machine is given in Fig. 420, while in Figs. 421 and 422 we reproduce two photographs of it taken from opposite sides.

The stage A on which the specimen to be tested rests is adjustable through a considerable vertical distance on guides formed on the front face of the machine column, the adjustment being made by means of a hand wheel and screw. At the top of the column enclosed below a dust-proof cover a lever B is pivoted. At one end this lever is weighted —C—while near the fulcrum at the other end it bears on a thrust rod D. This thrust rod lies within and presses against the foot of a freely moving tube E carrying a pyramidal diamond F in a chuck at its lower end. The lever B has arms in the ratio of 20 to 1, and towards the weighted end carries on the underside a small cone, which rests on a pad of soft rubber lying within a cup at the top of a plunger G. The foot of this plunger bears, through a roller, against the edge of a cam H. This cam is attached to a barrel which can be rotated—clockwise, as seen in the drawing which is reproduced below—by means

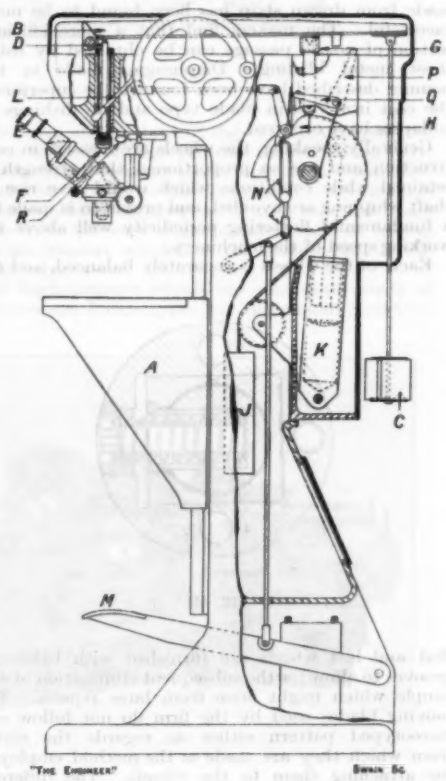


FIG. 420—DIAMOND HARDNESS TESTER—VICKERS

of an attached weight J. An oil dashpot K provided with an adjustable control valve regulates the rate at which the drum and cam rotate. At the beginning of a test the cam is released by a movement of the handle L, and after the test is over is restored to the operative position by pressure on the pedal M, N being a slotted link embracing a pin on the cam face. While the mechanism is being reset a tripping lever P holds the beam B in position until the plunger G rises sufficiently to support the beam. Thereupon the tripping lever falls out of engagement with the beam. An external indi-

cator Q is provided to show whether the machine is in the set or unset condition.

In use the stage A is raised until there is just a small gap between the specimen and the apex of the diamond tool, this adjustment being facilitated by the switching on of a small electric lamp R. On releasing the handle L the cam begins to revolve,

FIGS. 421 AND 422—OPERATING THE DIAMOND HARDNESS TESTER

and the plunger G to fall, with the result that the load on the beam is transferred on to the diamond point. The action of the rubber pad in the plunger is to cause the load to be applied in a graduated manner and without the transmission of inertia effects to the indenting tool. A period of about 30 seconds covers the rotation of the cam through the angle required to apply and maintain the load. Of this period the first five seconds or so are absorbed in taking up the gap between the work and the diamond. During the succeeding eight seconds about 40 kilos. of the load are applied to the specimen. The last eight or ten 10 kilos. are applied during the succeeding five seconds. During the remaining ten to twelve seconds the load is held on the specimen at the value now reached, namely, at about 20 kilos. The conclusion of the last period is indicated by a "click" in the mechanism, indicating the automatic release of the load, whereupon the operator resets the apparatus by means of the pedal M. If the gap allowed between the work and the diamond is excessive, too much time will be occupied in closing it and, as a consequence, the period during which the load is maintained at a constant value will be too short. As the length of time for which the load is held on is well known to affect the hardness figure obtained by the Brinell method, it has been arranged in the Vickers machine that a buzzer shall sound automatically if the constant load period is less than 10 seconds. The maximum duration of the constant load is 12 to 13 seconds, so that from maximum to minimum the range of possible variation in the time element is small.

The load having been removed from the specimen, the stage A is lowered sufficiently to permit a special form of microscope to be swung into position for the examination and measurement of the impression. In the act of swinging the microscope into position a small electric lamp within it is automatically brought into circuit for the illumination of the work. The focussing is effected by raising or lowering the stage A, with a fine focussing adjustment in the microscope itself.

As seen beneath the microscope the impression left by the pyramidal diamond is a square and not, of course, the familiar circle of the Brinell test. In the field of vision of the microscope the images of two knife edges are seen. The position of the left-hand image is adjusted by means of centring screws until the knife edge image just touches one corner of the square impression image. The second knife edge is then moved in or out parallel with the first, until its image is seen just to touch the diagonally opposite corner of the impression. The adjustment of the second knife edge is effected by means of a micrometer screw. The length of the diagonal as thus determined is read from a scale on the microscope and by means of a table can be directly converted into the hardness figure for the material under test. The image of a third knife edge can also be brought into the field of vision. For rapid repetition testing work this knife edge is set to correspond with the upper limit of hardness permissible in the material, while the second is set to suit the lower limit. With one corner of the impression adjusted against the first knife edge the material will be satisfactory as to hardness if the opposite corner falls visibly between the lines of the second and third knife edges.

The diamond tool has a pyramidal angle of 136 deg., and being a pyramid gives, unlike a ball, a geometrically similar impression, no matter what the depth may be, that is to say, no matter what may be the hardness of the specimen under test. The angle of the pyramid has been chosen at 136 deg. because, with the standard load of 50 kilos. on the tool, it yields figures closely approximating to those obtained with the standard Brinell ball and load when the diameter of the impression has the suggested ideal value of 0.375 times the ball diameter.

With a steel ball substituted for the diamond the machine may be used as a refined Brinell testing device. One incidental advantage, however, in the use of the pyramid form of tool is that across the corners of the impression where the measurement is taken no lip is thrown up, and hence one complication of the ordinary Brinell test is eliminated. The machine, it is claimed, is applicable by virtue of its diamond tool to the hardest of metals. The range of adjustment of the stage is such that specimens from the thinnest up to the thickness of 13in. can be accommodated. On very thin material the standard load of 50 kilos. is reduced to one of 10. For experimental work the load may be increased up to 100 kilos. We are informed that satisfactory measurements of the tensile strength of specimens may be made by multiplying the pyramidal figure by a constant factor, which for average steel is about 0.23.

Some Other Instruments.—A simpler type of hardness tester is the Vickers hardness comparator, which is made portable, so that it is capable of being applied to the surfaces of large and small metal parts. It is used for the approximate determination of the Brinell hardness of metals, and its compact form renders it particularly useful for work on assembled component parts, such as axles, tires, dies, &c. Another excellent instrument which has specially been designed for use in the workshop is the Vickers projection microscope. Its main purpose is to provide a method comparing the micro-structure of metals with approved standards made in the form of photo-micro-transparencies. In the instrument a sharply illuminated magnified image of the object to be tested is seen alongside a similarly illuminated standard of comparison. Means of direct vision are also provided, and there are diaphragms and light filters which enable the intensity of illumination to be varied. An illustrated description of this apparatus will be found in THE ENGINEER of June 27th. Among other laboratory instruments designed and made by Adam Hilger, Limited, of 75a, Camden-road, we may single out the special spectrometer for detecting the presence of nickel and chromium in steel bars. By means of this comparatively simple apparatus the approximate percentage of nickel or chromium present in a given steel may be rapidly determined. Various apparatus for photo-micrographical work is exhibited, and there is a well arranged series of original sections cut from steel ingots, as well as natural and sulphur prints. Among other objects we may single out perhaps a fine example of crystallised steel which was found in the head of an ingot by Colonel Vickers in 1872. Among the Barrow exhibits we noted samples of high-tension manganese bars of 52 tons tensile strength and Vickers Crown metal, a white metal used in gun mountings, capable of resisting a stress of 38 tons tensile. The remaining space in the laboratory is devoted to displays of scientific instruments made by associated firms and some examples taken from the Central Experimental Research Department's laboratory at Dartford. One such exhibit consists of apparatus which has been used to determine the ultra-violet absorption spectra of hydrocarbons in the vapour stage, which forms a

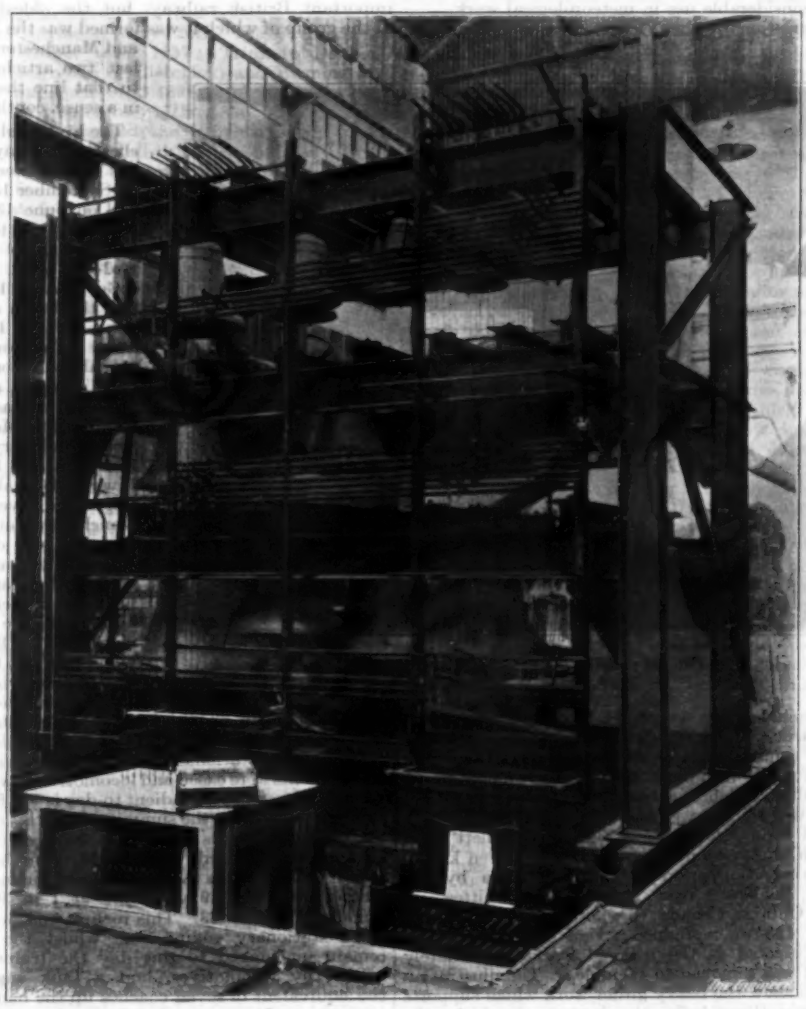


FIG. 423—CARILLON OF TWENTY-THREE BELLS—GILLETT AND JOHNSTON

rapid means of detecting the type of hydrocarbons present and their reaction on ultra-violet light. A liquid sample of the hydrocarbon to be tested is vaporised and the vapour passed through the annular space between two concentrically placed quartz tubes. Ultra-violet light, which is produced by two mercury vapour lamps, shines through the layer of gas bounded by the quartz tubes, and, passing out of a quartz-covered aperture, is received into a quartz spectrograph. Very interesting results, we learn, have been obtained from the first series of experiments which have been carried out with this apparatus. Other exhibits include apparatus for demonstrating Professor E. G. Coker's photo-elastic method of determining the stresses in structural members and machine parts, and a Nutting calorimeter made by Adam Hilger, Limited, which has been used by the Central Experimental Research Department for measuring the colour and light values of flares. This instrument permits a definite measurement of any colour to be rapidly made and expressed in terms of the wave length of the dominant hue and the percentage of white light emitted. Other Hilger exhibits include a strain viewer used by the Cosmos Lamp Works, Limited, for detecting strains in glassware which may be caused by imperfect annealing. Further Hilger exhibits include a Low-Hilger audiometer for recording by photographic means the forms of sound waves and a large quartz spectrograph for metallurgical work.

In the same room Cook, Troughton and Simms, Limited, of York, display a very complete collection of precise surveying instruments. Among them we noted examples of that firm's improved internal focussing telescopes, and a direct reading tachometer of the Jeffcott type. Other instruments worthy of note were the Foreday-Palmer stress recorder, which has been so successfully used on bridge work, and a new type of theodolite for balloon observation. In this instrument the telescope is of the Condé bent axis pattern and the incoming rays are diverted into the axis of the telescope by means of a pentagonal prism. The graduated circles are so arranged that they may be read simultaneously against an index common to both of them and fitted with a large achromatic magnifier. In actual field work one observer keeps the target in the field of the telescope whilst the other observer takes intermittent readings. This new pattern of theodolite has, we learn, proved of very considerable use in meteorological work.

A description of the Vickers Research Building, which includes, besides the laboratory, offices and a roof garden, in which effective use has been made of Vickers armoured plywood, would be incomplete were not mention to be made of the fine twenty-three-bell carillon which has been installed in the corner clock tower by the well-known firm of British bell-founders and clockmakers, Messrs. Gillett and Johnston, of Croydon. The carillon has been kindly lent during the period of the Exhibition by the Norfolk Soldiers' War Memorial Committee, of Simcoe, Ontario, Canada, to whose order it was built. In Fig. 423 we reproduce a view of the completed carillon erected in the makers' works immediately before it was removed to Wembley. The illustration serves to show the heavy girder work which supports the twenty-three bells, the largest of which—the tenor bell—weighs 1528 lb. The carillon is not as large as some on which the firm is engaged, but it covers a range of two octaves, with the exception of the two lower semi-tones. To the right of Fig. 423 will be seen the electro-pneumatic machine which is put in motion by releasing a balanced starting switch. Above the carillon is placed one of the firm's weight-driven tower clocks, which, by means of the automatic machine just referred to, chimes the Westminster quarters and strikes the hours, after which some popular air is played. Of greater interest perhaps is the hand clavier, which is shown at the lower right-hand corner of Fig. 423 and in detail in Fig. 424. This provides a method of playing the bells by striking the light wooden levers arranged in two groups with a pedal attachment. With this comparatively simple clavier it becomes possible to execute rapid and complicated cadences with delicate expression of tone. Messrs. Gillett and Johnston claim that the firm's method of bell tuning, whereby all the harmonics of each bell are brought into harmony with the fundamental tone, gives results as yet unattained by other methods. The success of the firm in obtaining commissions to build large carillons for the Netherlands and America would seem to bear out the claims made. Certainly the carillon at Wembley is remarkable for the clear and melodious tones of the bells, and more than usually interesting have been the carillon recitals given by the leading carilloneurs of Belgium and Holland. On July 5th a programme of bell music was played by Chevalier Jef Denyer, of Malines, which was very effectively broadcasted by the British Broadcasting Company. Later recitals were those of August 2nd, by M. Camille Lefevere, of Malines; and September 10th, by M. Staf Gebruers, of Antwerp. The makers of the carillon and Vickers Limited are to be congratulated on their enterprise, which has been the means of familiarising many people with perhaps hitherto unfamiliar and unappreciated bell music which is so reminiscent of the Low Countries.

FIG. 424—HAND CLAVIER FOR CARILLON

One Hundred Years of British Railways.

No. XI.*

PART II.—THE FIRST HALF-CENTURY.

THE LONDON AND NORTH-WESTERN RAILWAY.

IN beginning now a series of chapters that will describe the origin and evolution of the various railway systems it is fitting that the first to be dealt with should be the London and North-Western, for not only was it destined to become the most important British railway, but the oldest member of the group of which it was formed was the Liverpool and Manchester. As our last two articles related to that line the story is, in a sense, continuous.

The Liverpool and Manchester Railway was, as has been stated, opened on September 15th, 1830, and on June 13th of the following year there were brought into use the Bolton and Leigh—6 Geo. IV., c. 18, 1825—and the Leigh and Kenyon—10 Geo. IV., c. 36, 1829. The former was actually sanctioned before the Liverpool and Manchester, and was designed to join the Manchester, Bolton and Bury Canal at Bolton to the Leeds and Liverpool Canal at Leigh. When the Liverpool and Manchester Railway took shape it was desired to give rail communication with Bolton, and so the Leigh and Kenyon was built to fill the gap of 2½ miles. On the Bolton and Leigh line was the Daubhill incline, rising from Bolton by sections of 1 in 43, 1 in 55, 1 in 33 and 1 in 38. The distance from Bolton to the summit was about 3000 yards. Trains were hauled by stationary engines, but years afterwards the gradients were eased and locomotive power was employed. The steepest gradient to-day is 1 in 60, and the first 178 yards from the summit are on this degree and then, after 217 yards of 1 in 300, there is a continuous stretch of 1800 yards on 1 in 60. On the Kenyon side of the summit is the Chequerbent incline, 1¼ miles long, of which 1579 yards are at 1 in 30 and the remainder at 1 in 43. This incline, too, was worked by a stationary engine, and whilst the gradients remain unchanged to this day the trains are now hauled by locomotives, and a tank engine takes the equivalent of seven coaches up the bank without assistance. It was on the Chequerbent incline that the tests were made in 1904 which led to the Railway and Canal Commission accepting the contention of the Great Western Railway Company that the Dean-Churchward either-side brake complied with the essentials of the Railway Employment (Prevention of Accidents) Act, 1900, in that it could be applied or released from either side of the wagon. A triangle was laid in at Kenyon so that trains from Bolton could proceed to either Liverpool or Manchester. The Leigh and Kenyon was amalgamated with the Bolton and Leigh by 6 Will., IV., c. 52, 1836.

The Warrington and Newton Railway had for its object the joining of Warrington to the Liverpool and Manchester at what is now Newton-le-Willows. It was sanctioned by 10 Geo. IV., c. 37, 1829, and was opened on July 25th, 1831. The line, only 4½ miles long, was destined to form a very important part of the English railway system as it became the northern end of the Grand Junction Railway. But before the latter line is mentioned three others must be noticed. The Wigan Branch Railway—11 Geo. IV., c. 56, 1830—was a line which ran from Parkside, just east of Newton, to Wigan, whilst the Preston and Wigan—1 Will. IV., c. 56, 1831—controlled by a separate company, continued the Wigan Branch to Preston. The former was opened on September 3rd, 1832, but the Preston line did not make such good progress. The delay was greatly to the annoyance of the Wigan Junction people, who had the backing of the leading people of the Liverpool and Manchester. The upshot was the formation of the North Union—4 Will. IV., c. 25, 1831—to take over both the Wigan Branch and the Preston and Wigan. The latter line was then completed and opened on October 31st, 1838. Part of the Preston line was carried on the fine viaduct over the river Ribble at Preston. This structure consists of millstone grit—it still stands but has been widened on the west side—with five arches of 120ft. span, rising 33ft. on piers 20ft. thick. Rail level is 44ft. above the water.

From July 16th, 1840, rail communication was given by the Preston and Wyre—to be noticed under the Lancashire and Yorkshire Railway—to Fleetwood, whence there was a steamship service to Ardrossan for Scotland.

The third railway to be noted was the St. Helens and Runcorn Gap line. It was sanctioned by 11 Geo. IV., c. 61, 1830, and opened in 1833. It had no relation with the other lines, and whilst passing over the Liverpool and Manchester line had no connection therewith, being built solely for the purpose of conveying coal from the St. Helens district to the river Mersey for shipment. In 1845 this company and the Sankey Brook Navigation Company were, by 8 and 9 Vic., c. 117, amalgamated as the St. Helens Canal and Railway Company, which, in 1864, became part of the London and North-Western Railway.

Reverting to the Grand Junction, it should be observed that that railway was sanctioned by 3 Will. IV., c. 34, 1833, and ran from the Warrington and Newton at Warrington to Birmingham, 78 miles. It was not only the most ambitious railway scheme up to that time sanctioned, but it was designed to interlink Liverpool, Manchester and Preston with Birmingham, and thence, by the London and Birmingham with the Metropolis. This last was not part of the original scheme, and it was not until the following year that a junction with the London and Birmingham was sanctioned with, also, a branch to Wolverhampton.

There were two remarkable financial points about the Grand Junction: (1) The Bill for its construction met with no opposition—the parliamentary expenses amounted to only £22,157—and (2) the line was built for £1,500,000, which was within the estimate. Locke was the engineer and the line was opened on July 4th, 1837.

Among the works of note on the line the following may be noted. The Warrington viaduct crosses the river Mersey and the Mersey and Irwell Canal. The arches over the river are each of 75ft., and that over the canal is of 40ft. span with three approach arches of 16ft. span each on either side, and three between the river and the canal. North of Acton Station and south of the present Weaver Junction, where the Liverpool line of to-day leaves the main line to the north, is Dutton Viaduct over the river Weaver. It is 1400ft. long, has twenty arches, each of 63ft. span, and cost £60,000 to build. North of Winsford is Vale Royal Viaduct, also over the Weaver. It has five arches, each of 63ft. span, with rail level 66ft. above the water. Crewe was spoken of in a work of the period as being "furnished with all the appliances which belong to one of the first-class (stations). It possesses a booking office and convenient waiting rooms, an engine shed and a handsome house for the agent." The Grand Junction locomotive works were originally at Edge Hill, and it was not until 1843 that they were transferred to Crewe.

Eleven miles south of Crewe the line reaches 390ft. above sea level. It is approached from the north by "Madeley Bank," on which were stretches of 1 in 330, 1 in 269, 1 in 177 and 1 in 348. At Penkridge, south of Stafford, is a seven-arched bridge over the river Trent, and after passing through Bushbury the highest point—440ft. above sea level—on the line is reached. Birmingham, at that time, was approached from the north *vid* Aston where was a viaduct of ten arches over the Birmingham and Fazeley Canal, the Birmingham and Lichfield turnpike road and a small canal. The structure was spoken of as being "of singular and varied design, ingeniously adapted to the many purposes it had to accomplish." This was a reference

* No. X. appeared September 5th, 1924.

to the fact that certain arches are askew and have piers that are wider on one side than the other. Birmingham was entered from the south and the Grand Junction station was alongside that of the London and Birmingham Company. The direct line from Wolverhampton to Birmingham—known as the Stour Valley line—which included New-street Station, Birmingham, was not opened until June 1st, 1852.

The Grand Junction, by 5 Will. IV., c. 8, 1835, absorbed the Warrington and Newton, and by 8 and 9 Vic., c. 198, 1845, the Liverpool and Manchester and the Bolton and Leigh. The latter, as already related, had amalgamated with the Leigh and Kenyon in 1836.

The London and Birmingham was the next to be sanctioned of the railways which were to form the London and North-Western Railway. The scheme was even more ambitious than that of the Grand Junction. It was authorised by 3 Will. IV., c. 36, 1833, but ought to have been sanctioned a year earlier. In 1832 a Bill passed all its parliamentary stages up to the third reading in the House of Lords. At that point it was rejected for reasons given in the following resolution:—"Resolved that the directors have not made out a case which would warrant the forcing of the proposed railway through the lands and properties of distinguished landowners and proprietors." The promoters, thereupon, increased their estimate for the cost of the land required from £250,000 to £750,000, and the Bill was passed the following year. The line, however, cost £5,500,000 instead of the estimate of £2,750,000, but the works were unparalleled in size. The line at the London end was to have started at Camden, but, under 5 Will. IV., c. 56, 1835, the passenger terminus was made in Euston Square and the change added £380,000 to the cost. Nothing was provided in the estimates for stations and the 1839 Select Committee on Railway Communication was told that this had led to "a most fearful excess over the estimates." Furthermore, the locomotives cost £1200 instead of the £900 which was the price when the estimate was prepared in 1834. The soil in Kilsby Tunnel proved to be of a totally different nature from what was expected and provided for. A quicksand developed and the contractor abandoned the work. Robert Stephenson, the engineer for the line, undertook to finish the tunnel, and he successfully did so, but instead of the work costing £99,000 it cost £300,000. Two of the shafts used in the construction of the tunnels were retained for ventilation purposes. One is 130ft. and the other 60ft. deep, and each is 60ft. in diameter.

Euston Station had an arrival and a departure platform with two sidings between the platform lines. These roads are still in use—the former arrival road being now No. 7 and the departure No. 8—and are in that part of Euston Station known as The Field. The carriage shed was in the north-eastern corner of the station and contained fifteen roads which were fed by one single road with a turntable for each of the fifteen cross roads. Each carriage was put away singly. All movements were made by turntables, 12ft. diameter, and there was a turntable on each platform road and each siding at the north end of the station for access to and from the carriage shed; four turntables in the middle of the station for interchange between those roads and four at the southern end of the station. The station was 80ft. wide, with the roof in two bays, and 200ft. long. Between the two sidings was a row of columns for carrying the roof and about these columns there is an interesting story. The transfer of the carriages between the carriage shed and the station was a little later done by a traverser, which had to pass between two columns, the space apart of which determined the length of the traverser, and this in turn ruled the length of the carriages on the whole of the London and North-Western system. The result was that 33ft. was, until quite a late period, the greatest length of coach used by that company. The public entrance to the station was under the well-known Doric portico, 72ft. high, erected at a cost of £35,000 to the designs of Philip Hardwick.

For the first mile out of Euston there is the "Camden bank," of 1 in 70, 1 in 112 and 1 in 77. At the Camden end of this length was a bridge over the Regent's Canal, which deserves mention because of the fact that its girders remained in use until 1923—a period of about 88 years. Under the Euston Extension Act of 1835, the company was prohibited from using locomotive power beyond Camden, and so the line between that point and Euston was worked by ropes. The engine-house was, actually, under the railway at Camden and a stationary engine on each side, with two chimneys, one on each side, 133ft. high. Locomotive working was introduced in 1844, and heavy trains were then assisted by a banking engine in front. This pilot was connected to the train engine by a slip coupling, and when the train was near the top of the bank the slip coupling was undone and the assistant engine spurted forward and was turned by a ground pointsman through some facing points into a special siding, the points of which were at once re-opened for the main line. This arrangement continued until about 1869, when the assistant engines began to work through to Willesden and be detached there. As R. C. Rapier said in his paper, "The Fixed Signals of Railways"—Vol. 38, Proc., Inst. C.E.—"This is a remarkable testimony that facing points, well looked after, are not necessarily dangerous."

The principal engineering features on the line were as follows:—Primrose Hill Tunnel, 1182 yards; Kensal Green Tunnel, 320 yards; Watford Viaduct, with five arches, each of 43ft. span; bridge over the river Colne, 312ft. long, with five arches of 30ft. span; Watford Tunnel, 1817 yards long; bridge over the London-road at Boxmoor with a skew of 32 deg. and a span on the square of 21ft.; North Church Tunnel, 351 yards; the summit of the line at Tring, 300ft. above the level at Euston and 420ft. above sea level; Tring cutting, 2½ miles long, of an average depth of 40ft., from which were removed 1,500,000 cubic yards of earth; the locomotive shops at Wolverton, which, in 1862, became the carriage shops of the London and North-Western; Wolverton Viaduct, 660ft. in length, of six arches of 60ft. span each, cost £28,000; Roade cutting, whence were removed 1,000,000 cubic yards of material at a cost of about £250,000; Stowe Tunnel, 503 yards long; drawbridge at Weedon over the channel between the Grand Junction Canal and the military depôt; Weedon Viaduct of five arches, each of 50ft. span; Kilsby Tunnel, the difficulties in constructing which have already been referred to, 2426 yards long. After passing through Rugby there is the viaduct over the river Avon—a structure of nine arches, each of 24ft. span. Outside Birmingham is a viaduct, with ten arches of 50ft. span and a total length of 711ft. which cost £16,000 to build. The terminus was in Curzon-street, now a goods depôt, and was 217ft. long and 113ft. wide. The roof was in two spans, and in the front of the station was, as at Euston, a fine entrance, with four Ionic columns, also designed by Hardwick and costing £26,000.

In order to ensure that they obtained the best permanent way possible the directors of the London and Birmingham offered a prize of 100 guineas for "the most improved construction of railway bars, chairs and pedestals, and for the best manner of affixing and connecting the rail, chair and block to each other, so as to avoid the defects which are felt more or less on all railways hitherto constructed." The judges were Rastrick, Nicholas Wood and Peter Barlow.

The line was opened in the following order:—Euston to Boxmoor, July 20th, 1837; Boxmoor to Tring, October 16th, 1837; Tring to Denbigh Hall (1¼ miles north of Bletchley) and Birmingham to Rugby on April 9th, 1838, and Denbigh Hall to Rugby on September 17th, 1838. At Denbigh Hall the railway crossed the Holyhead main road, and until the Denbigh Hall-Rugby section was opened passengers to and from north of Denbigh Hall had to change from rail to road conveyance and *vice versâ*. That fact is recorded on a tablet on the southern side of the bridge which carries the railway over the main road.

On June 10th, 1839, the Aylesbury Railway was opened. It was sanctioned by 7 Will. IV., c. 127, 1836, ran from Aylesbury to Cheddington on the London and Birmingham, and was worked by that company, but in 1846 was purchased by the London and North-Western Railway.

Before leaving the year 1838 it may be remarked that in that year mails were first conveyed by railway, when the Grand Junction converted a horse box into a postal sorting carriage. In that year also the night mail from Euston was instituted and a mail-bag exchanging apparatus was fixed at Boxmoor. Strange to relate the methods employed on the train and on the ground for setting down and picking up the mail bags are practically the same to day as they were nearly ninety years ago.

The opening of the London and Birmingham and of the Grand Junction and the latter's absorbed companies, had brought railway communication from London as far north as Preston, 209 miles. The next stage was to carry it to Lancaster and this was done by the Lancaster and Preston Railway—sanctioned by 7 Will. IV. c. 22, 1837, and opened on June 21st, 1840. The Lancaster and Carlisle, which was to carry the railway onwards to the Scottish border, was not sanctioned until 1844 so, for the moment, it cannot be referred to. It is, however, necessary to state that the Lancaster and Preston was, in 1842, leased for twenty-one years to the Lancaster Canal Company, but the legal formalities were not completed. Meanwhile the construction of the Lancaster and Carlisle was making progress, and the authorities of the latter were anxious as to securing communication with the North Union at Preston. They determined to work their trains throughout between Carlisle and Preston. The board of the Lancaster and Preston objected but, being helpless, resigned. The Lancaster and Carlisle thereupon put the through working into operation when its line was opened in 1846. The receipts for the Lancaster–Preston portion were kept separate, and statements were sent monthly to the Lancaster and Preston and the Lancaster Canal companies, but it was intended that no money for tolls should be paid until it was determined to whom it was due. This difficulty was solved on November 13th, 1848, by the Lancaster and Preston buying itself back from the Canal Company and, under 12 and 13 Vic. c. 87, 1849, being leased to the Lancaster and Carlisle. At Galgate there is a bridge, 265ft. long, consisting of six arches of 30ft. span each, and at Scorton a similar bridge 263ft. long.

Meanwhile Manchester was awaiting direct railway communication with the south instead of through Newton and Warrington. It was given by the Manchester and Birmingham Railway, sanctioned by 1 Vic. c. 69, 1837. Its route was from the former city, through Stockport and Congleton, to Chelsey on the Grand Junction, and had branches from Alderley to Crewe and from Cheadle Hulme to Macclesfield. The line from Alderley to Chelsey was subsequently dropped, and the Manchester and Birmingham became a railway between Manchester and Crewe and Cheadle Hulme and Macclesfield. The line on leaving Manchester is carried on a viaduct of 20 arches, of which all, except that over Fairfield-street, is in brick of spans of 30ft. to 45ft. That over Fairfield-street had cast iron girders and was built on a skew of 24½ deg. The span on the skew was 128ft. 9in. and on the square 54ft. Stockport is approached by a viaduct 2179ft. long, consisting of 22 arches each of 63ft. span and of a maximum height of 109ft. South of Stockport is a tunnel 297 yards long. At Wilmslow is the Bollin Viaduct, 630ft. long and with 11 arches, each of 49ft. span. Further south is the Dane Viaduct which has 23 arches of 63ft. span, has a maximum height of 95ft., is 1717ft. long, and cost £54,000. On the Macclesfield line there is a tunnel 260 yards long at Prestbury and another 928 yards at Macclesfield. The line was opened thus:—Manchester–Heaton Norris on June 4th, 1840; Heaton Norris–Sandbach on May 10th, 1842; Sandbach–Crewe, August 10th, 1842; and Cheadle Hulme–Poynton on June 9th, 1845 and Poynton–Macclesfield on November 25th, 1845.

The same year that saw the Manchester and Birmingham authorised saw the Chester and Crewe sanctioned—1 Vict. v. 63, 1837. It was opened on October 1st, 1840. That line became of great possible value when it was, in 1840, determined that the mail route to Ireland should be by Crewe and Holyhead. Without, therefore, waiting to absorb the Liverpool and Manchester and the Bolton and Leigh, the Grand Junction, by 384 Vic. c. 49, 1840, obtained possession of the Chester and Crewe Railway, for fear it should fall into the hands of the Manchester and Birmingham.

One other event of the year 1840 should be mentioned. It was the opening, on July 1st, 1840, of the Midland Counties line into Rugby. The main original purpose of that line was to carry coal from the Derby and Notts coalfield, and when the line was opened it was proposed to send coal for London over it for transfer to the London and Birmingham at Rugby. The outdoor superintendent of the latter line was an old army officer—Captain H. P. Bruyeres. When this proposal came before him he remarked: "What! coal by railway; they will be asking us to carry dung next." His opposition to such a step led to only six wagons at one time being allowed, and those were to be covered by tarpaulins and only conveyed to Crick, whence the coal was to be transferred to the Grand Junction Canal and complete its journey by water.

In 1843 the locomotive, carriage and wagon shops of the Grand Junction were removed from Edge Hill and established at Crewe under F. Trevithick, the son of Richard Trevithick. They are now known as the Old Works, occupying 2½ and 3 acres. Ten years later—on June 10th, 1853—the rail mill was opened and, in the same year the wagon shops at Earlestown, near Newton-le-Willows, were established. In 1857 the locomotive work hitherto done at Wolverton was transferred to Crewe, which became the locomotive and carriage shops for the whole of the London and North-Western system. The carriage work was transferred to Birmingham in 1859 and, in 1862, to Wolverton. In April, 1862, John Ramsbottom became the locomotive superintendent for the whole of the system; in 1864 the steel works were opened, and in 1871 F. W. Webb succeeded Ramsbottom.

The year 1844 saw the completion of a small but very important piece of work. By that time the Manchester and Leeds was opened from Manchester to Normanton, whence the North Midland gave access to Leeds; the York and North Midland to Milford and York; and the Leeds and Selby and the Hull and Selby from Milford to Hull. Through rail communication from Liverpool to the places named could not be given as the Liverpool and Manchester ended, in the latter city, in Liverpool-road. The last named company, agreed, however, to continue its line to Hunts Bank, and the Manchester and Leeds agreed to build a connection from the Oldham-road line at Miles Platting to Hunts Bank, and thus to give through rail communication between the west and east coasts. There was some delay on the part of the Liverpool and Manchester people, and it was not until April, 1842, that its portion was put in hand. The Manchester and Leeds connection was opened, together with Victoria Station, on January 1st, 1844, and the Liverpool and Manchester share was completed on May 4th.

The Warwick and Leamington Union Railway from Coventry was sanctioned by 5 Vic. c. 81, 1842. It was absorbed by the London and Birmingham under

6 and 7 Vic. c. 64, 1843, and opened on December 9th, 1844. By 6 and 7 Vic. c. 64 of 1843, the latter company was authorised to build a line from Blisworth to Peterboro, which was opened on June 2nd, 1845.

The present article may be fittingly closed by observing that in 1845, by 8 and 9 Vic. c. 198, the Grand Junction which had already acquired the Warrington and Newton and the Chester and Crewe, absorbed the Liverpool and Manchester and the Bolton and Leigh—the last included the Leigh and Kenyon. The following year, by 9 and 10 Vic. c. 204, the Grand Junction, the Manchester and Birmingham and the London and Birmingham were amalgamated as the London and North-Western Railway.

The Riverside Sewerage Scheme of the Romford R.D.C.

THE Romford Rural District Council is the sanitary authority over a large area, immediately to the east of London, which comprises nine parishes and contains 30,000 acres. Previous to 1910 the policy which it pursued in sanitary matters and sewage disposal was to provide each parish with a system of sewers and sewage disposal works sufficient for that parish's requirements only, so that it was independent of the other districts. Under that policy some six parishes, the greater portion of which were more of an urban or suburban than rural nature, were sewered and works constructed. Three small parishes are at the present moment unsewered, but they are of a strictly rural description with a very small population.

About 1910 the Council determined that the policy of separate works for each parish should not be further pursued, and that in the future an attempt should be made to consolidate and combine several parishes in one system having one outfall. About

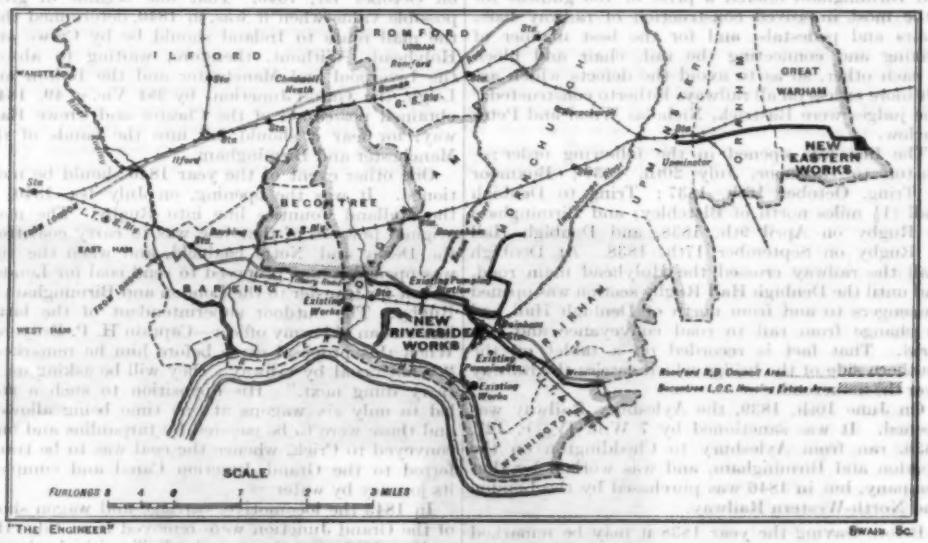


FIG. 1—MAP SHOWING ROUTES OF SEWERS AND POSITION OF RIVERSIDE DISPOSAL WORKS

1914 new works being required for the Upminster district, this new policy was put into operation, and new works, called the Eastern Works, were constructed with an outfall sewer some two miles long, so as to take by gravitation to the pump well practically the whole of the sewage of four parishes lying north of the Southend line—see Fig. 1. These new works—which were opened two years ago—are designed so as to be easily and economically extended to meet future requirements on an area of 12 acres of land in the south-east corner of the district.

The district south of the Tilbury line, reaching along the river Thames for some four miles, forms a more difficult problem in the matter of main drainage than the northern portion of the Council's district, which lies between the Southend line and the Tilbury line. Along the riverside there is a width of low marsh land varying from half a mile to one mile in width, all below high-water mark, which is at such a level as to make it almost impracticable to sewer on the ordinary systems except at heavy expense. This area, however, can never be developed for housing, but will in the future be developed for industrial purposes, offering, as it does now, the advantages of river frontage, water carriage, railway facilities, and very shortly electric power from the new station at Barking. A few years ago the whole of the area in question was utilised almost wholly as pasture, but within the past ten years a considerable amount of development has taken place, and factories—some of a large size—are numerous, while prospects of more intensive development are imminent.

About 1920 the sewerage works at Dagenham for Dagenham parish, having reached the limit of capacity, and new works being required for South Hornchurch, the question of extending the Dagenham works was under discussion when the London County Council Becontree housing scheme was brought forward. It is needless to dwell on the various steps that were gone through from the time of this housing scheme being proposed until the time when it was possible to proceed with new sewerage works on the riverside. The housing scheme is concerned with an area of approximately 3000 acres—a large portion of which is in Dagenham parish—with a prospective population of about 150,000. The Romford Rural District Council, when applied to for drainage, expressed its willingness to proceed with any reasonable scheme so long as some financial facilities were given, as the cost would be more than the rateable value of the district could stand.

It was first intended to proceed with the construction of new works of a size sufficient to take the whole population. That proposal was latterly, by agreement with the Ministry of Health, modified, and it

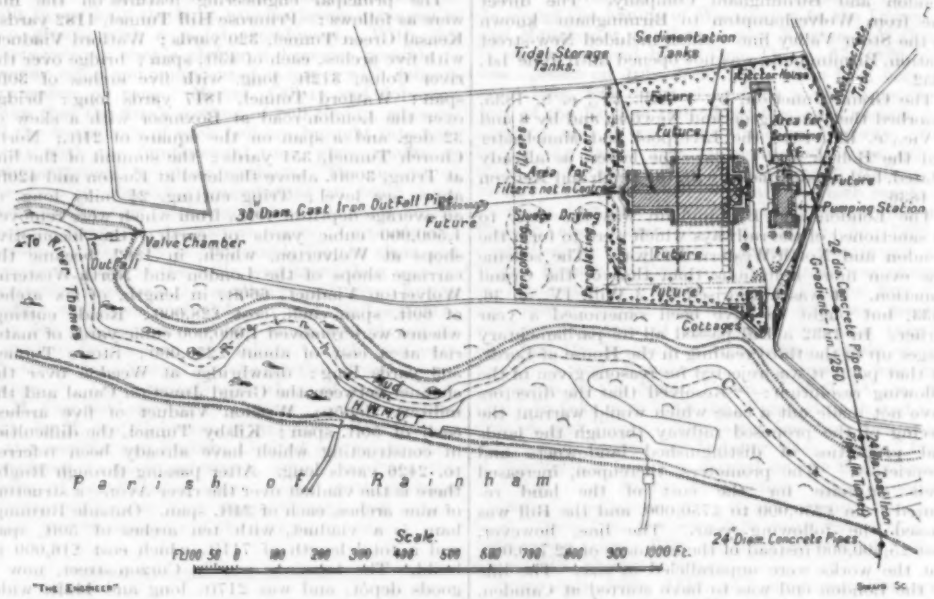


FIG. 2—PLAN OF RIVERSIDE SEWAGE DISPOSAL WORKS

was ultimately agreed that a central site on the riverside should be secured in such a position that main intercepting sewers east, west and north could be constructed so that the sewage could be delivered by gravitation to the works, thus abolishing several existing pumping stations and outfall works. The site selected comprises 30 acres of land south of the Tilbury line on the banks of Rainham Creek. This site, part of which is shown in Fig. 2, has many advantages for works of this nature; it is isolated, it has a navigable creek along its boundary for taking away or bringing in by water stores and materials, and has also a direct outfall into a tidal creek communicating with the main river. It has one disadvantage, viz., that, in common with all marsh land along the riverside from Barking to Tilbury, foundations of heavy buildings are difficult to get and require special treatment, as large areas have beds of peat, soft sands and mud up to considerable thicknesses.

From the site of the works intercepting sewers have been laid westwards, consisting of 3ft. and 4ft. diameter concrete sewers over a distance of two miles to a point some little distance east of the boundary with Barking parish, giving a junction at Gores Bridge, on the Tilbury Road, to take in the whole of the sewage to be discharged from the portion of the Becontree area that is within the district of the Romford Rural District Council. Eastwards there are intercepting sewers 24in. and 21in. in diameter of concrete, carried below Rainham Creek in a tunnel extended in 18in., 15in. and 12in. diameter pipe sewers, terminating near the eastern boundary of the Council's district at Wennington. The whole of the intercepting sewers, which have been constructed in extremely difficult ground, join together in a junction chamber constructed on the site of the outfall works

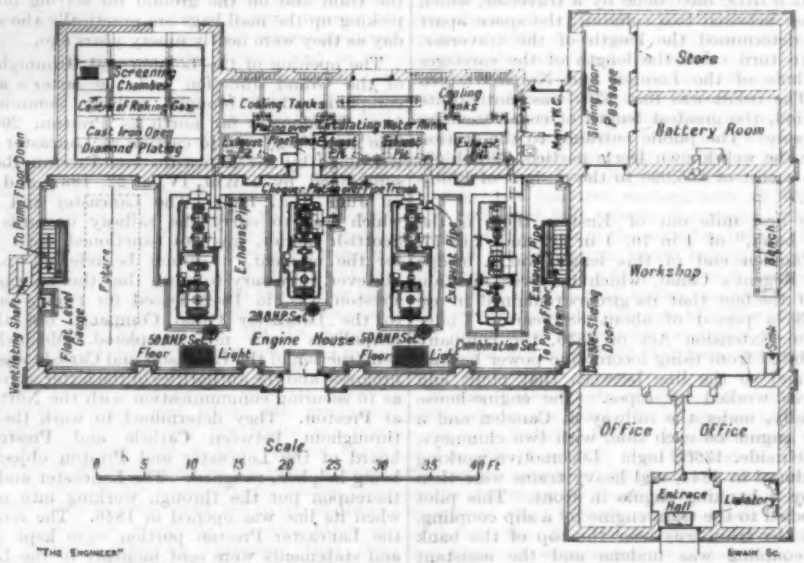


FIG. 3—PLAN OF PUMPING STATION

and directly connected with the new pump well. The main sewer westwards to Becontree is a portion only of the future scheme. By arrangement with the London County Council practically the whole of

the Becontree estate in Dagenham will be sewered on the strictly separate system. This system has been in use by the Romford Rural District Council for many years in its various parishes and found to answer all requirements. By this restriction of storm water getting access to the sewers—by agreement with the Ministry of Health—the main intercepting sewers have only had to be given a capacity of three and a-half times the dry weather flow instead of the usual six, which would otherwise have been required, and naturally that has had an appreciable effect in reducing the initial capital expenditure on the outfall sewers and new works. The contractors for Sections 1 and 3 of the main sewer were Thomas Muirhead and Co., Limited, and for Section No. 2 Munday and Sons, Limited, both of London.

While the outfall sewer could not be restricted in size to meet only the immediate wants of the district, the outfall works could with advantage be so restricted, and they were designed of a capacity sufficient for the existing population only, the lay-out being such that by adding units of tanks or filters one design would be ultimately carried out for the whole population of about 200,000.

The new works at Rainham, which are known as the Riverside Works, consist of a pump well, with a pump-room, an engine-room, offices and workshop constructed over it, two large conical depositing tanks, four sedimentation tanks, each of which is provided with two cone depositing tanks; two tidal storage tanks, and an outfall into Rainham Creek. At present the outfall has one line of 30in. cast iron pipes, which, owing to the nature of the ground, are laid on a platform of concrete, the whole pipe being encased in concrete to protect it from the acid water usually found in the marshes, which readily attacks cast iron work.

As before mentioned, the site is difficult on the question of foundations and over the whole area covered by the tanks, channels, &c., a system of concrete *in situ* piling was put down to the ballast at approximately 7ft. 6in. centres, two lines of piles under each wall and four lines of piles below each tank floor, the whole concrete flooring formed above these piles being reinforced with heavy expanded metal. Similar piles were put down under the lighter portion of the buildings, and also under the outfall, and the cottages constructed for the staff. The "piles" were formed by first of all boring a vertical hole by means of a boring tool, which could be operated by two men, and then quickly filling up the hole with concrete—see Fig. 5. They have proved most satisfactory. The pumping station buildings—see Figs. 3 and 4—are carried down on to the ballast, and the pump-room, engine-room and other departments are built up from and over the pump well. This piece of work was very troublesome, owing to the difficult nature of the ground passed through. The contractors for the buildings and outfall works generally were Thos. Muirhead and Co., Limited.

The sewage on leaving the junction chamber before referred to passes into a screening chamber where mechanical screening apparatus has been installed, which, at present, is fitted for working by hand only,

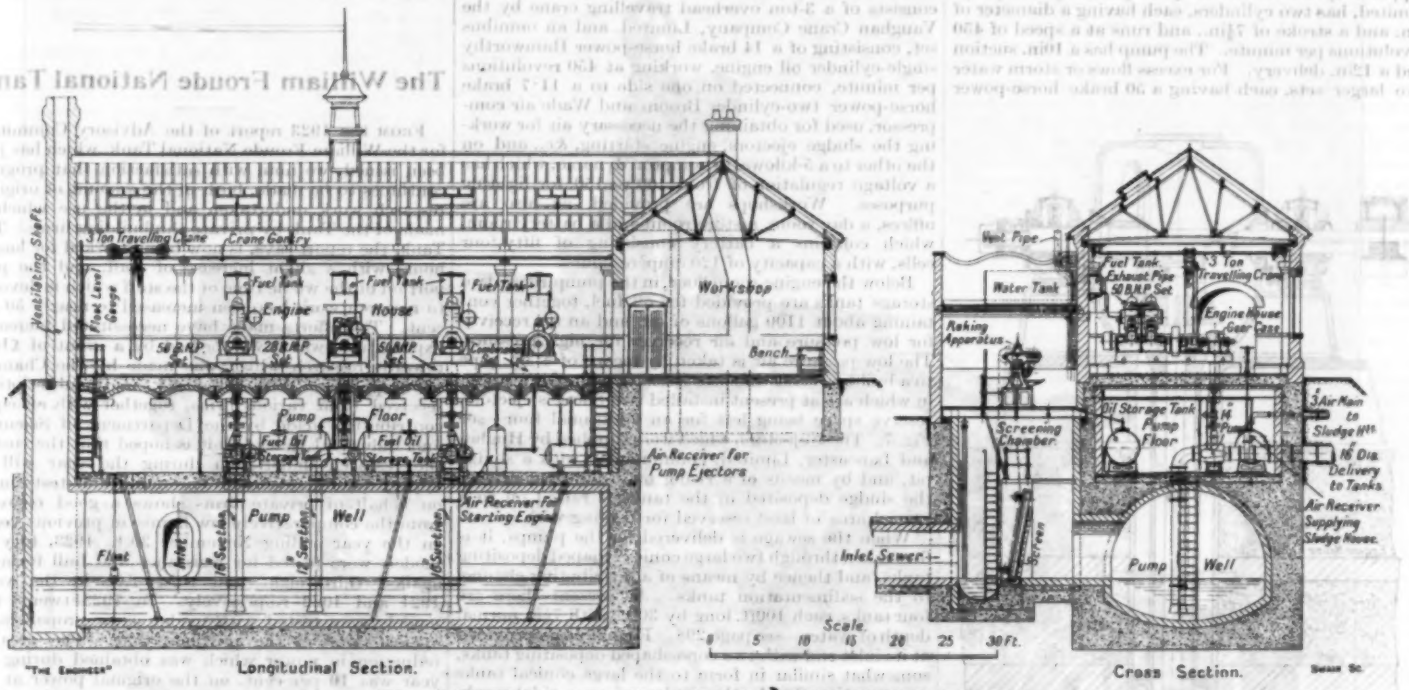


FIG. 4—LONGITUDINAL AND CROSS SECTIONS THROUGH PUMPING STATION

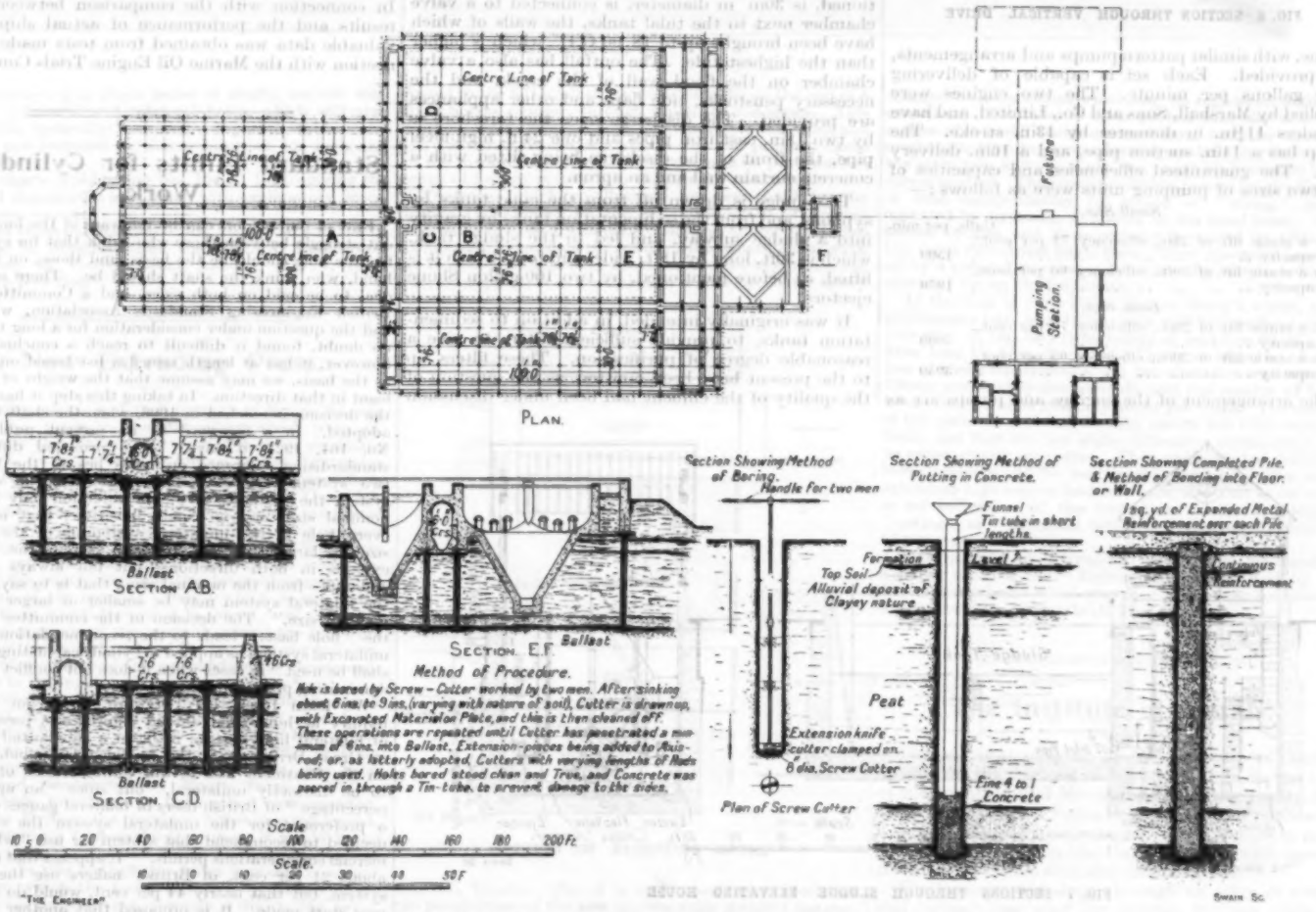

Plan.
Section AB.
Section E.F
Section C.D
Method of Procedure.
Hole is bored by Screw-Cutter worked by two men. After sinking about 6ins. to 9ins. (varying with nature of soil), Cutter is drawn up, with Excavated Material on Plate, and this is then cleaned off. These operations are repeated until Cutter has penetrated a minimum of 6ins. into Ballast. Extension-pieces being added to Axis-rod; or, as latterly adopted, Cutters with varying lengths of Rods being used. Holes bored stood clean and True, and Concrete was poured in through a Tin-tube, to prevent damage to the sides.
Section Showing Method of Boring.
Handle for two men
Section Showing Method of Putting in Concrete.
Funnel
Tin tube in short lengths.
Section Showing Completed Pile & Method of Bonding into Floor or Wall.
1 sq. yd. of Expanded Metal Reinforcement over each Pile.
Formation Level
Top Soil
Alluvial deposit of Clayey nature
Peat
Extension knife cutter clamped on
6 dia. Screw Cutter
Plan of Screw Cutter
Fine 4 to 1 Concrete
Continuous Reinforcement
Future
Pumping Station.
Scale.
0 10 20 30 40 50 Ft.
Scale
10 5 0 20 40 60 80 100 120 140 160 180 200 Ft.

FIG. 5—PLAN AND SECTIONS OF SEWAGE TANKS, AND METHOD OF FORMING *in situ* CONCRETE PILES

but which is so constructed that it can be adapted in the future for power driving.

The pumping station itself is an oil-driven station, the engines being of the hot bulb type, and is provided with one small unit, 28 brake horse-power, connected to a Worthington pump capable of delivering 1500 gallons per minute. The engine, which was supplied by the Hamworthy Engineering Company, Limited, has two cylinders, each having a diameter of 8in. and a stroke of 7½in., and runs at a speed of 450 revolutions per minute. The pump has a 10in. suction and a 12in. delivery. For excess flows or storm water two larger sets, each having a 50 brake horse-power

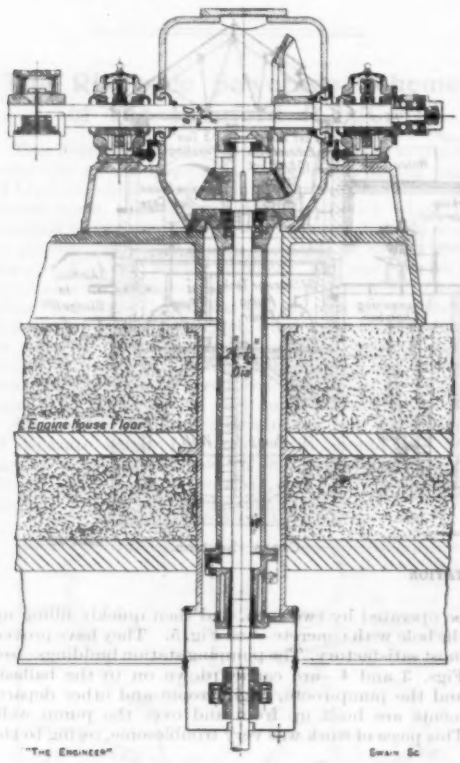


FIG. 6—SECTION THROUGH VERTICAL DRIVE

engine, with similar pattern pumps and arrangements, are provided. Each set is capable of delivering 3000 gallons per minute. The two engines were supplied by Marshall, Sons and Co., Limited, and have cylinders 11¼in. in diameter by 13in. stroke. The pump has a 14in. suction pipe, and a 16in. delivery pipe. The guaranteed efficiencies and capacities of the two sizes of pumping units were as follows :—

Small Size.

	Galls. per min.
On a static lift of 28ft., efficiency 73 per cent., capacity	1500
On a static lift of 20ft., efficiency 60 per cent., capacity	1930

Large Size.

On a static lift of 28ft., efficiency 75 per cent., capacity	3000
On a static lift of 20ft., efficiency 65 per cent., capacity	3950

The arrangement of the engines and pumps are as follows :—The engines, which are in every case of the two-cylinder pattern, stand on the engine-room floor and are connected through flexible couplings with a gear-box containing double helical gear—see Fig. 6—running in an oil bath and driving a vertical shaft prolonged downwards into the pump-room to the pumps, each shaft being supported on thrust bearings having the usual water-cooling arrangements. The cooling water tanks are all situated in a building outside, to the north of the engine-room. The contractors for the pumping machinery generally were Worthington-Simpson, Limited, of London; Marshall, Sons and Co., Limited, of Gainsborough; and the Hamworthy Engineering Company, Limited, of Poole. An interior view of the engine house is given on page 298.

The auxiliary plant provided in the engine-room consists of a 3-ton overhead travelling crane by the Vaughan Crane Company, Limited, and an omnibus set, consisting of a 14 brake horse-power Hamworthy single-cylinder oil engine, working at 450 revolutions per minute, connected on one side to a 11·7 brake horse-power two-cylinder Broom and Wade air compressor, used for obtaining the necessary air for working the sludge ejectors, engine starting, &c., and on the other to a 5-kilowatt Crompton dynamo, which has a voltage regulation of from 100 to 150, for lighting purposes. Workshops are provided, as also are offices, a day room, a store room and a battery room, which contains a battery consisting of fifty-four cells, with a capacity of 120 ampère-hours.

Below the engine-room floor, in the pump-room, two storage tanks are provided for oil fuel, together containing about 1100 gallons of oil, and an air receiver for low pressure and air receiver for high pressure. The low-pressure air is taken by means of a 3in. pipe to a building some distance from the pumping station, in which are at present installed two Shone's ejectors, reserve space being left for an additional four—see Fig. 7. These ejectors, which were supplied by Hughes and Lancaster, Limited, communicate with a sludge pit, and by means of a rising main 7in. in diameter the sludge deposited in the tanks is raised on to a special area of land reserved for dealing with it.

When the sewage is delivered by the pumps, it is first taken through two large conical-shaped depositing tanks, and thence by means of a distributing channel to the sedimentation tanks. At present there are four tanks, each 100ft. long by 30ft., with 7½ft. normal depth of water—see page 298. Each tank is provided at its inlet end with two cone-shaped depositing tanks, somewhat similar in form to the large conical tanks just mentioned. As the works are on a tidal creek, provision had to be made for storing a certain amount of effluent during certain times of the tide, so that two tidal storage tanks have been constructed, adjoining the sedimentation tanks, each 100ft. long, 30ft. wide and 6½ft. normal depth of water. Subways are provided for drawing off sludge and passing sewage or effluent from one tank to another or, if necessary, back to the pump well.

The effluent outfall pipe, which, as before mentioned, is 30in. in diameter, is connected to a valve chamber next to the tidal tanks, the walls of which have been brought up to 18.00 O.D., which is higher than the highest tide. The outfall has also a valve chamber on the flood wall of the creek, and the necessary penstocks, tide flaps and other appliances are provided. The discharge over the foreshore is by two 18in. cast iron pipes and one 24in. high-level pipe, the front of the discharge being fitted with a concrete curtain wall and an apron.

The sludge is drawn off from the cone tanks by syphons, and from the sedimentation tanks by gravity into a sludge subway, and led to the sludge tank, which is 30ft. long by 18ft. wide, and from which it is lifted, as before mentioned, by two 100-gallon Shone ejectors.

It was originally intended, in addition to sedimentation tanks, to provide sufficient filters to give a reasonable degree of purification. These filters up to the present have been omitted, as the question of the quality of the effluent had been under discussion with the Ministry of Health and the Port of London Authority, and taking into consideration the position of the works, a large volume of the river at this point being tidal, and the capacity, &c., of tankage provided, it was considered that the tank effluent was sufficient. The works are equipped with all the usual apparatus necessary for carrying out pumping operations and sewage disposal. There are two cottages, one for the resident manager and the other for his assistant. The contractors for both were Baker, Hammond and Laver, Limited, of Rainham.

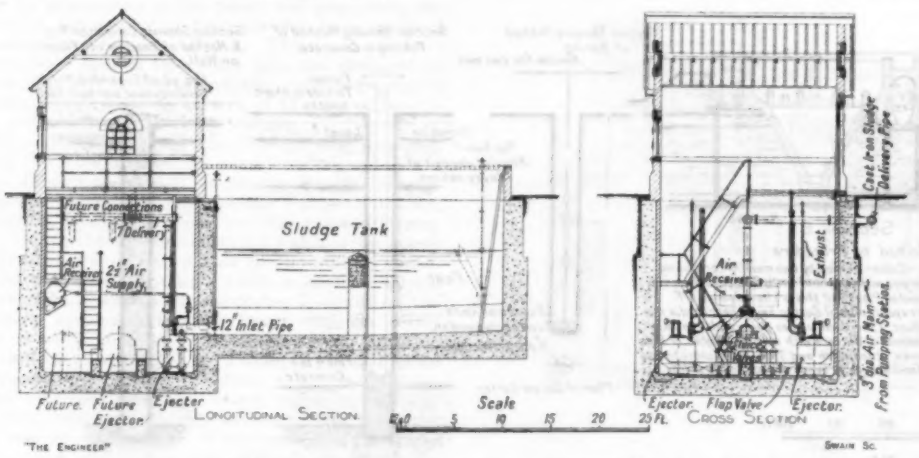


FIG. 7—SECTIONS THROUGH SLUDGE ELEVATING HOUSE

We are indebted to Mr. William Fairley, M. Inst. C.E., of Westminster, the consulting engineer for the works, for the particulars given in the foregoing, and for the drawings from which our illustrations have been prepared.

The William Froude National Tank.

FROM the 1923 report of the Advisory Committee for the William Froude National Tank, which has just been issued, we note with satisfaction that progress continues to be made, both in the amount of original research work undertaken and in the use which is made of the Tank by private shipbuilding firms. The Tank, the report says, is now being worked for longer hours with a slight increase of staff, and the proportion of the whole time of the staff which is devoted to research work has been increased to nearly 50 per cent. The efforts made have necessitated increased expenditure, which was helped by a grant of £1000 towards research which was made by the Chamber of Shipping. With this gift and subscriptions received from various firms, together with an equal contribution made by the Department of Scientific and Industrial Research, it is hoped that the cost of the research undertaken during the year will be approximately covered. The number of tests made on behalf of private firms shows a good recovery from the comparatively low figures of previous years. In the year ending November 30th, 1923, fifty-six models were tested for resistance and hull form, as against thirty-eight and thirty-five in the years 1921 and 1922 respectively. In 1923 twenty-two models were tested with model screw propellers, as against four in the previous year. The greatest reduction in power which was obtained during the year was 10 per cent. on the original power at the service speed of a ship without any alterations either of dimensions or displacement. With regard to aeronautical work a special sub-committee has been appointed to consider and report on research work to be undertaken in connection with flying boats and seaplanes, and a definite sum of money has been allocated for such work. Further research has been completed on the manœuvring of ships and has been extended to the consideration of the effect of shoal water on steering, which work is being continued. In connection with the comparison between model results and the performance of actual ships, some valuable data was obtained from tests made in connection with the Marine Oil Engine Trials Committee.

Standard Limits for Cylindrical Work.

FEW of our readers can be unaware of the long drawn-out struggle between those who think that for cylindrical fits the hole should be the basis, and those, on the other hand, who think the shaft should be. There is a great deal to be said on both sides, and a Committee of the British Engineering Standards Association, which has had the question under consideration for a long time, has, no doubt, found it difficult to reach a conclusion. As, however, it has at length issued a list based on the hole as the basis, we may assume that the weight of evidence leant in that direction. In taking this step it has reversed the decision it reached in 1906, when the shaft basis was adopted. In a foreword to its present publication—No. 164, 1924—it says: "The principal difficulty in standardising tolerance on holes lies in the fact that two systems are in common use. In the unilateral system the tolerance is in one direction only from the nominal size, and is usually positive; that is to say, every hole in the unilateral system is of the nominal size or larger. In the bilateral system the tolerance extends in both directions—but not always in equal amounts—from the nominal size; that is to say, holes in the bilateral system may be smaller or larger than the nominal size." The decision of the committee to adopt the "hole basis" leads to the recommendation that the unilateral system, as applied to cylindrical mating surfaces, shall be used "in cases when it does not conflict with predominating present practice."

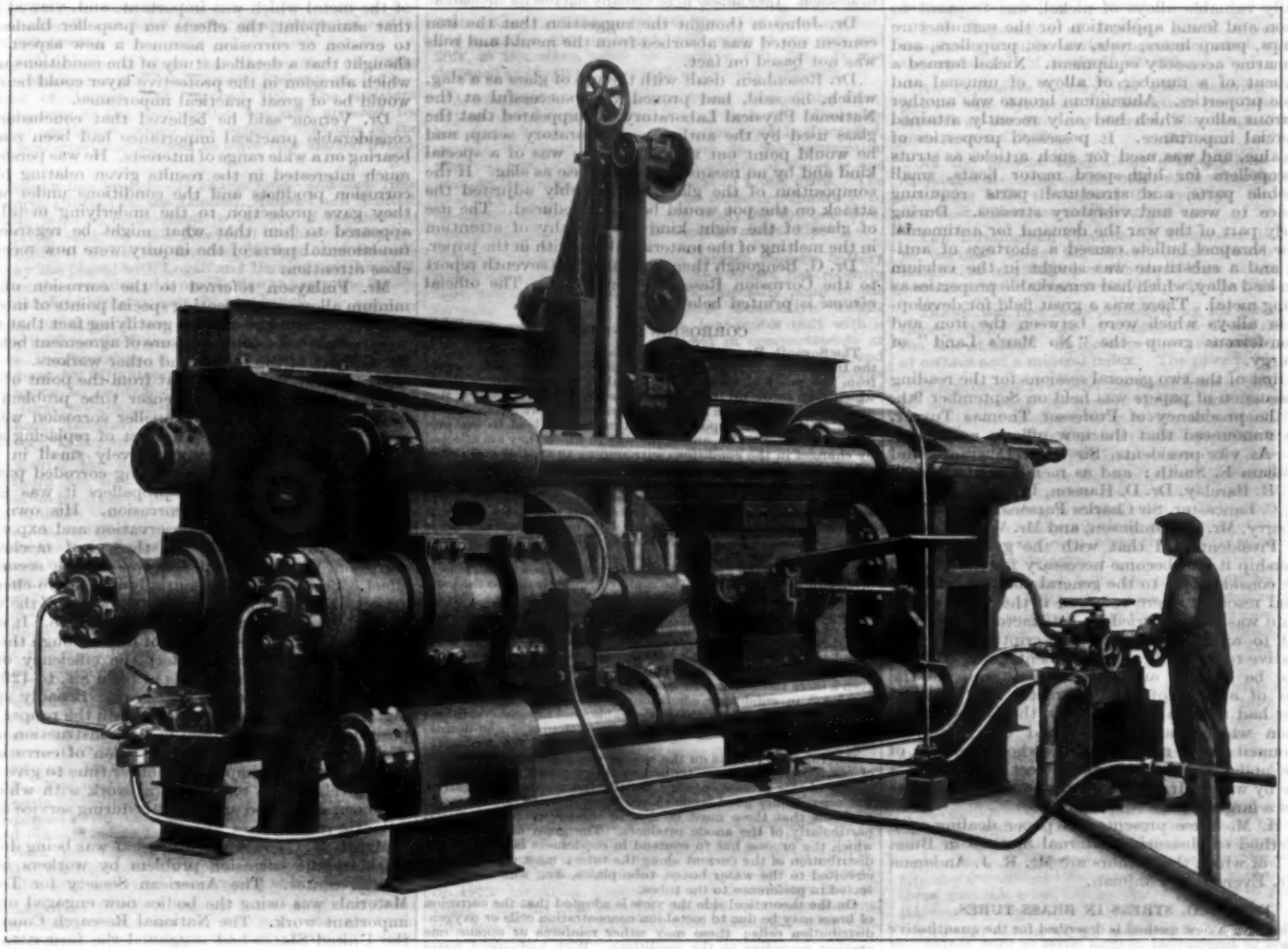
We learn from this Foreword that "an extensive inquiry at home and abroad showed the present users of bilateral limit gauges to be in a substantial majority in Great Britain, and the tendency in standardisation on the Continent and in the United States of America to be distinctly unilateral," but since "an appreciable percentage" of British users of bilateral gauges expressed a preference for the unilateral system the committee decided to recommend that system for use "where commercial considerations permit." It appears that at present about 21 per cent. of British makers use the bilateral system, but that nearly 44 per cent. would do so were a new start made. It is proposed that another census of industry be taken to ascertain the result of the publication of the report.

The report gives directions for using the tables of British standard tolerances for both unilateral and bilateral holes, for shafts and for the fits obtained by the mating of the shafts with certain of the holes, and concludes with diagrams giving a graphical representation of the various tolerances and fits.

A noteworthy feature of this publication, and one which is likely to prove exceedingly useful to engineers,

A NEW EXTRUDING PRESS

HENRY BERRY AND CO., LTD., LEEDS, ENGINEERS



is the adoption of a single series of shafts, for use with both the unilateral and bilateral holes, which will give all the fits generally required. Separate tables and diagrams are included in this publication for inch and metric units.

A wall chart—Publication No. 164 B, 1924—giving the tables and diagrams in inch units, with explanatory notes, has also been issued.

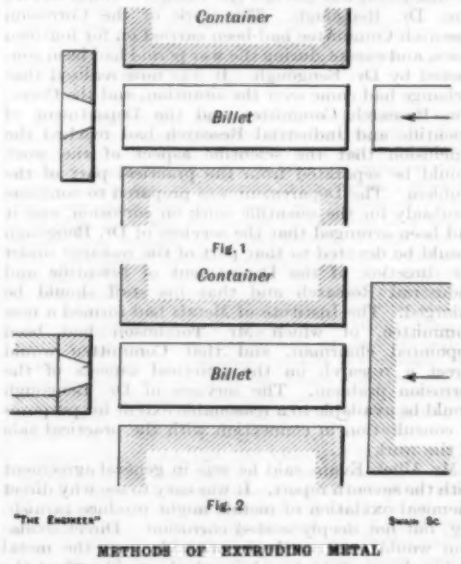
Copies of these publications—Nos. 164, 1924, and 164 B, 1924—may be obtained from the B.E.S.A. Publication Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. each post free.

A New Extruding Press.

IN a leading article in THE ENGINEER of March 7th last, reference was made to the difficulties which were encountered by the makers of extruded bars in producing sound work, owing to what is known as the "extrusion defect." This defect consists of longitudinal unsoundness which affects the inner portions of the bar. The origin of the trouble is not certain, but it is generally attributed to one of two sources. Metallurgists differ in their opinions on the subject, but the Research Department, Woolwich, after long experience and much experimental work, has arrived at the conclusion that this internal unsoundness is the result of the peculiar "flow" which occurs in the container from which the metal is forced, and that as a result some portions of the original skin of the billet are pushed into the central parts of the bar near the tail end. Others attribute much of this unsoundness to corresponding defects in the ingot.

As an outcome of the investigations of the Research Department, Woolwich, some of the results of which have been published by Mr. R. Genders, M. Met. F.I.C., in the *Journal* of the Institute of Metals, No. 2.P.237, 1921, an extruding press, entirely novel in principle, has been designed and constructed by Henry Berry and Co., Limited, Leeds, to extrude by the method recommended, in order to obviate the troubles hitherto experienced. Before attempting to describe this press, it would be as well to indicate briefly the usual method adopted in extrusions. In this method, the billet is placed in a container, from which the metal is forced by means of an hydraulic ram on the right, through a die on the left—as shown in the sketch, Fig. 1. In the new machine made by Messrs. Berry and illustrated above, there is an essential difference in the manner in which the metal is caused to flow. This difference can be explained by reference to the sketch, Fig. 2, which shows the billet in the container; but it will be noted that instead of the hydraulic ram on the right-hand side forcing the metal through the die on the left, the process is reversed. Hydraulic pressure, exerted by a large ram, is applied to the container and the billet on the right-hand side, and the two are forced to the left against the stationary die on the end of a fixed hollow plunger, through which the rod issues. This method avoids relative movement between the billet and the container, which is stated to be the primary cause of the inward flow of the billet skin, and so prevents the entry of foreign matter into the interior of the rod.

The press which we illustrate has been built for the Indian Government on the recommendation of Colonel Lawrence Archer, Ordnance Consulting Officer for India. It has been evolved as the result of the experimental work at Woolwich, followed by an exhaustive survey of present extrusion practice in a number of works by Henry Berry



METHODS OF EXTRUDING METAL

and Co., Limited, who, it is understood, concluded that the possibilities of the new process fully justified the considerable amount of work necessary to the introduction of a new type of press. The press, which is covered by Messrs. Henry Berry and Co.'s patents, consists essentially of four parts, an hydraulic cylinder and ram, a gag and charging arrangement, a movable container, and a fixed hollow plunger. The method of charging the billet into the container is worthy of special mention, as by this method under normal conditions the extrusion process can be begun within a few seconds of the billet leaving the furnace. In operating the press, the heated billet is charged on to a ramp, which can be registered with the container. The billet is then pushed into the latter by means of a small hand-operated ram, and the charging mechanism is pulled across, leaving a solid "gag" between the main ram and the container, to which hydraulic pressure is applied. The container can be moved longitudinally or held independently by means of "vicing" rams, operated by hydraulic cylinders in the fixed head. It is heated by gas, and its movement is guided by slides on two stout cylindrical guide bars. The "discards" are cut off by a circular saw—seen in its raised position—which is operated by an electric motor.

At the time of our visit to Messrs. Berry's works, some preliminary tests were being made with the machine on the extrusion of 1in. bars from billets of lead-free 60/40 brass 24in. long by 4¼in. diameter. The time taken to convert one of these billets into a rod 1in. diameter was between fifteen and twenty-five seconds, and the residue of billet left in the container was only about ¾in. thick. The makers of the press are satisfied that the results will fulfil expectations, and that the few slight difficulties encountered can be satisfactorily overcome. They claim that a definitely lower pressure can be used in the new press, even when extruding high copper lead-free bars, and that so far there is no indication of the formation of the ring-shaped "coring" or "extrusion defect," even after extrusion of 95 per cent. of the billet.

This method of extruding metals was discussed in a paper entitled the "Extrusion of Brass Rod by the Inverted Method," which was read at the autumn meeting of the Institute of Metals on Tuesday last.

The Institute of Metals.

No. I.

THE autumn meeting of the Institute of Metals opened on the evening of September 8th, in the hall of the Institution of Mechanical Engineers, when Mr. H. M. Corse (United States Research Council) delivered a special lecture on some recent developments in non-ferrous metallurgy in the United States, with special reference to nickel and aluminium bronze.

The lecturer said that, although an alloy of nickel and copper was used for coinage as long since as 235 B.C., the importance of nickel as an engineering material was not recognised until in 1889 James Riley, of Glasgow, directed attention to nickel steel in a contribution to the Iron and Steel Institute. Nickel was employed to a considerable extent for armour plate and ordnance, and the market for it had been disorganised by the limitation of armaments. Canada supplied 90 per cent. of the world's supply of nickel and the output of refined nickel was

about 60 million pounds a year. The adoption of pure nickel for coinage purposes in Europe had brought with it an appreciable demand. Over 1800 tons of nickel were consumed for coinage purposes last year. Monel metal, one of the most interesting and commercially valuable alloys of nickel, was resistant to corrosion and found application for the manufacture of pumps, pump liners, rods, valves, propellers, and other marine accessory equipment. Nickel formed a constituent of a number of alloys of unusual and valuable properties. Aluminium bronze was another non-ferrous alloy which had only recently attained commercial importance. It possessed properties of great value, and was used for such articles as struts and propellers for high-speed motor boats, small automobile parts, and structural parts requiring resistance to wear and vibratory stresses. During the early part of the war the demand for antimonial lead for shrapnel bullets caused a shortage of antimony, and a substitute was sought in the calcium barium lead alloy, which had remarkable properties as a bearing metal. There was a great field for development in alloys which were between the iron and the non-ferrous group—the "No Man's Land" of metallurgy.

The first of the two general sessions for the reading and discussion of papers was held on September 9th, under the presidency of Professor Thomas Turner. It was announced that the new officers nominated were :—As vice-presidents, Sir John Dewrance and Sir William E. Smith ; and as members of Council, Mr. W. R. Barclay, Dr. D. Hanson, Dr. R. S. Hutton, Mr. H. C. Lancaster, Sir Charles Parsons, Mr. F. A. C. Lantsberry, Mr. F. Tomlinson, and Mr. W. G. Turner.

The President said that with the growth of the membership it had become necessary for the Council to give consideration to the general position. Larger financial resources were required if the work of the Institute was to be carried on satisfactorily. It was desired to avoid raising the subscription, and the alternative to that was an endowment fund. He was glad to be able to announce that to provide the nucleus of a fund of that character Mr. Leonard Sumner had made a gift of £1000, the largest single donation which the Institute had ever received. The Council would now bring the whole question of finance under review with the object of framing a scheme by which Mr. Sumner's gift could be made the basis of a larger plan.

Mr. H. M. Corse presented a paper dealing with "A Method of Measuring Internal Stresses in Brass Tubes," of which the authors are Mr. R. J. Anderson and Mr. Everett G. Fahlman.

INTERNAL STRESS IN BRASS TUBES.

In this paper a new method is described for the quantitative estimation of longitudinal internal stress in tube shapes—for example, cold-drawn brass tubes. It is shown that the major stress is longitudinal, and the stress in the outer part of the wall of the tubing is a longitudinal tensile stress, while that in the inner portion is a longitudinal compressive stress. The summation of the balanced stresses, of course, is zero. Absence of circumferential stress in tubes is indicated by the failure of diametrically cut rings to spring in or out on being slit in two. Experiments showed that the usual cutting methods which have been applied to bars and rods for the estimation of stress are not applicable to tubes, especially where the bulk of the stress is longitudinal.

The method described in the paper for measuring longitudinal internal stress is called the strip method, and is carried out by slitting a narrow strip longitudinally in a piece of tubing ; for example, a strip 2.75in. long and 0.10in. wide in a 3.25in. tube length ; and then releasing one end of such a slit strip by cutting. Stress is indicated by the springing out of the freed end and can be calculated by a formula based upon the modulus of elasticity of the material and the distance in movement of the freed end.

The method is useful for determining the amount of internal stress in cold-drawn tubes, and for examining quantitatively the effect of a low-temperature anneal upon stress release. It has often been thought that because cold-drawn brass does not crack on application of an accelerating cracking agent it is free from internal stress. The strip method is applicable for the quantitative estimation of stresses inferior to those necessary for cracking under the application of mercurious nitrate.

Professor Honda said the method described was not new in principle, but would be very useful to engineers and metallurgists. What was being measured by the authors was the average stress along the length of the tube. But there were also local stresses in tension and compression. It was a question whether it was possible to measure the absolute internal stresses in the cold-worked specimens or the quenched steel. Professor Honda proceeded to make suggestions as to how this might possibly be done.

Dr. W. Rosenhain was inclined to doubt whether the authors had succeeded even in measuring relative stresses. It seemed probable that the method of determining changes of length were not sufficiently delicate.

Mr. J. H. Watson then gave a summary of a paper of which he and Sir Thomas K. Rose are the joint authors, on "Experiments on the Working of Nickel for Coinage."

NICKEL FOR COINAGE.

The experiments described in this paper were made in order to determine the conditions in which nickel for coinage could be cold rolled in the existing rolls at the Royal Mint. It was found impossible to prepare coins containing 99 per cent. nickel with 1 per cent. of manganese, magnesium, carbon, iron, silicon, &c., such as are manufactured with the aid of hot rolling. By the addition of 2 per cent. manganese, however, castings can be prepared suitable for cold rolling and conversion into coin. The carbon must not exceed 0.2 per cent. and the bars should be not less than 1in. thick and 2in. wide. The maximum crucible charge tried was 100 lb. Mond nickel with the addition of not more than 50 per cent. of scrap makes a suitable charge. Four annealings are necessary, two at 800 deg. during rolling and one at 675 deg. after rolling and before cutting. The blanks are also annealed. Air is excluded during annealing. The blanks are cleaned before striking by rumbling in a wooden drum with half their weight of nickel pellets in a 2½ per cent. acetic acid solution for half an hour. The coins consist of a solid solution and accordingly resist tarnishing and corrosion equally well with those containing 99 per cent. or more of nickel, such as are in circulation abroad. The two kinds of coin are indistinguishable in appearance, similarly magnetic and equally hard and resistant to abrasion. They appear to be similarly suitable for circulation.

Dr. Johnson thought the suggestion that the iron content noted was absorbed from the mould and rolls was not based on fact.

Dr. Rosenhain dealt with the use of glass as a slag, which, he said, had proved very successful at the National Physical Laboratory. It appeared that the glass used by the author was laboratory scrap, and he would point out that that glass was of a special kind and by no means the best to use as slag. If the composition of the glass was suitably adjusted the attack on the pot would be much reduced. The use of glass of the right kind was worthy of attention in the melting of the materials dealt with in the paper.

Dr. G. Bengough then presented the seventh report to the Corrosion Research Committee. The official *résumé* is printed below.

CORROSION RESEARCH.

The Seventh Report to the Corrosion Research Committee of the Institute of Metals considers the problem of corrosion largely from the point of view of the "scale" of corrosion products which soon forms on the surfaces of such metals as copper, zinc and brass immersed in sea water. In the Report an account is given of the more important reactions which lead to the production of these scales, and of the way in which they are affected by changes in the conditions surrounding the metal and in the composition of the metal itself. The studies of copper and zinc are preliminary to that of brass. An important feature of the Report is the study of the behaviour of high-speed streams of aerated sea water in glass and brass tubes and the correlation of the behaviour of such streams with local corrosion. It is suggested that a large proportion of tube failures in modern condensers is due to local impingement of aerated sea water, and that the actual distribution of corroded tubes in condensers often supports this view. The rapid corrosion is due to the local removal of protective scale by the impinging stream. Certain types of preformed scale, however, may be very resistant to this type of action, and a useful field of work has been opened up in this direction. The occurrence of "dezincification" has been found to be due, not to bad mixing of copper and zinc in the manufacture of brass, but to the absence of arsenic from tubes ; even a mere trace of arsenic has been found to prevent "dezincification" in condenser conditions. The presence of arsenic, however, is by no means always desirable, and in some conditions a "dezincing" tube may behave better than a "non-dezincing" tube.

Careful observations on the electrolytic method of protection of condenser tubes have tended to throw grave doubts on the utility of this process, *per se* ; usually the results are negative, but occasionally good results have been reported, and it seems probable that these must be due to chance secondary effects, particularly of the anode products. The great difficulty with which the process has to contend in condensers is the uniform distribution of the current along the tube ; most of it is short-circuited to the water boxes, tube plates, &c., which are protected in preference to the tubes.

On the theoretical side the view is adopted that the corrosion of brass may be due to metal-ion concentration cells or oxygen-distribution cells ; these may either reinforce or oppose one another according to the conditions. With high-speed water streams the metal-ion concentration cell may become the more powerful and render the metal anodic and severely corroded ; deposits of sand, porous masses of corrosion products, &c., may cause oxygen distribution cells to become active and set up local corrosion, but the most rapid cases of corrosion seem to belong mainly to the former type. Sometimes the two types of action reinforce one another, as when pits are started by oxygen-distribution effects, owing to the unequal porosity of the scale ; the thin layer of scale which covers them is finally broken down by the action of an impinging aerated water stream and the attack is carried on by the action of a metal-ion concentration cell.

The Report is a bulky document covering 150 pages, and contains a large amount of information about various and little-known phases of condenser tube corrosion ; it is impossible to give an adequate summary in the space at our disposal.

Dr. H. C. H. Carpenter said the report brought up for discussion was the last the Institute would receive from Dr. Bengough. The work of the Corrosion Research Committee had been carried on for fourteen years, and except during the war period had been conducted by Dr. Bengough. It was now realised that a change had come over the sitaution, and the Corrosion Research Committee and the Department of Scientific and Industrial Research had reached the conclusion that the scientific aspect of the work should be separated from the practical part of the problem. The Department was prepared to continue a subsidy for the scientific work on corrosion, and it had been arranged that the services of Dr. Bengough should be devoted to that part of the research under the direction of the Department of Scientific and Industrial Research and that his staff should be enlarged. The Institute of Metals had formed a new Committee, of which Mr. Tomlinson had been appointed chairman, and that Committee would direct a research on the practical aspects of the corrosion problem. The services of Dr. Bengough would be available to a reasonable extent for purposes of consultation in connection with the practical side of the work.

Mr. Ulick Evans said he was in general agreement with the seventh report. It was easy to see why direct chemical oxidation of metals might produce tarnishing, but not deeply seated corrosion. Direct oxidation would create a layer of oxide over the metal and in direct contact with it, which would protect the underlying metal. On the other hand, electrochemical corrosion might produce an insoluble corrosion product at a sensible distance from the surface which would not put an end to the attack. With regard to the function of impurities, homophase impurities had no direct stimulative effect on corrosion and might, indeed, as in the cases of chromium and iron, reduce it. Heterophase impurities could set up corrosion, particularly in zinc and iron. The complete covering up of the surface of a material by a protective deposit might be the best means of avoiding attack, but if at one point the surface was scraped away the effect might be very serious. This type of local corrosion was to some extent a combination of mechanical erosion and electro-chemical corrosion. It was the mechanical properties of the scale and not of the metal which was important, and, viewed from that standpoint, the effects on propeller blades due to erosion or corrosion assumed a new aspect. He thought that a detailed study of the conditions under which abrasion in the protective layer could be made would be of great practical importance.

Dr. Vernon said he believed that conclusions of considerable practical importance had been reached bearing on a wide range of interests. He was personally much interested in the results given relating to the corrosion products and the conditions under which they gave protection to the underlying metal. It appeared to him that what might be regarded as fundamental parts of the inquiry were now receiving close attention.

Mr. Finlayson referred to the corrosion of aluminium alloys, as presenting special points of interest. The report brought out the gratifying fact that there was now a considerable measure of agreement between the authors of the report and other workers.

Mr. Arthur Marks said that from the point of view of the shipowner the condenser tube problem was important, but hull and propeller corrosion were of even more importance. The cost of replacing a few condenser tubes was comparatively small in comparison with the cost of replacing corroded parts of the hull. In the case of propellers it was rather mechanical erosion than corrosion. His own conclusions as the result of observation and experience were at variance with the theory of mechanical corrosion, which, he believed, was only a secondary effect. Corrosion was essentially an electro-chemical action. No doubt in condensers the speed of the water through the tubes was a contributory cause. It would be possible to reduce the rate of flow through the condenser, but that would affect the efficiency of the plant as a whole, and speeds of from 8ft. to 12ft. per second were regarded as necessary. Broadly speaking, the thing to aim at was to obtain the proper composition for the metal used in the construction of the condenser. On the general question of corrosion in marine service he hoped at another time to give some figures relating to experimental work with which he had been associated and of trials during service on the Atlantic route.

Mr. H. M. Corse referred to what was being done to elucidate the corrosion problem by workers in the United States. The American Society for Testing Materials was using the bodies now engaged on this important work. The National Research Council of the United States had suggested the formation of a Corrosion Committee, and that Committee, which had been formed and of which he was chairman, would take steps, not to carry out research work, but to correlate and co-ordinate the researches in hand and prevent overlapping. That task was being undertaken in conjunction with the Bureau of Standards and the Institution of Massachusetts. It should be recognised that corrosion was not a national, but a world problem.

The reply to the discussion, which was dealt with quite briefly by Mr. May, will be given by correspondence.

Papers were presented by Mr. R. Genders, on "The Extrusion of Brass Rod by the Inverted Process ;" and by Dr. D. Hanson and Miss Grace W. Ford, on "An Investigation of the Effects of Impurities in Copper : Part II., The Effect of Iron on Copper."

A luncheon was held at the Connaught Rooms, on the invitation of the London members and manufacturers and business houses. It was largely attended. Sir Westcott Abell proposed the toast of "The Institute of Metals," which was acknowledged by the President.

SIXTY YEARS AGO.

WE devoted a long leading article in our issue of September 9th, 1864, to a problem which after all those years seems to be as far from solution as it was then—"What is an Engineer"? One eminent man, we say, told us that "an engineer in the true sense of the word must have the differential and integral *calculi* at his finger's ends ; that he must be able to treat every portion of his work in the most abstract manner, and to soar into mathematical sublimities on the smallest question." Another man equally famous said that an engineer "must be naturally gifted in the highest degree with the faculty of invention." A "numerous class" held that "a real engineer must be able to handle the file, the chipping hammer, the turning tool, and the drawing pen, with equal ease and facility. He must be able to take the tool out of any man's hands in the shop and show him how it should be handled." The first of these three kinds of engineers we held to be German or French, the second American, and the third English. Finally, we found that the world's definition of an engineer was a "fine office in Great George-street." Our own definition of an engineer was "a man more or less gifted with the constructive and philosophical faculties, furnished with a sound education in the modern sciences, and one who has passed as much, or more, preparatory time in the workshop as in the lecture room." As a definition that would hold very well in the present day. Clearly we believed as strongly then as we do now that neither technical education nor adequate apprenticeship can be omitted in the making of an engineer.

Railway Matters.

A MESSAGE from Madrid states that the Ministro de Fomento has been authorised to invite tenders for the electrification of the third section of the railway line between Lerida and Saint Girons, at an estimated cost of 8,078,950 pesetas.

THE latest reports show that the number of deaths in the Montgomery–North-Western Railway of India—disaster of August 29th reached 107. The assistant stationmaster at the next station has been arrested for criminal negligence, which fact suggests that one of the trains concerned was allowed to leave that station irregularly.

A SINGLE line branch—74 chains long—and loop from Blidworth (Notts.) on the London, Midland and Scottish Railway is to be constructed to the site of the new pit now being sunk by the Newstead Colliery Company. The contract, which the London, Midland and Scottish Railway has placed with Logan and Hemingway, Limited, includes the provision of a new bridge to carry the Southwell–Mansfield highway over the new banch.

OVER 400 miles of new lines will be opened to public railway traffic in the Union of South Africa shortly. They include the branches, Heilbron to Petries Steyn, and Lydenburg to Olifantoportje, Hercules to Magaliesberg, Oudtshoorn to Calitzdorp, and Towns River to Ladysmith (first portion), September, 1924; Rustenburg to Boschhoek, October, 1924; Fort Beaufort to Balfour, December, 1924; and Ermelo to Lothair, March, 1925.

RECENTLY the first electric locomotive left Pietermaritzburg for Glencoe Junction (Natal). It did not proceed under its own power, however, as it was coupled to an ordinary engine. The primary object of the trip was to enable tests to be made respecting the clearance between the top of this type of engine and the various overhead wires, which are to supply the electric current. In a few months time the first section of the line between Ladysmith and Mooi River will be ready, but not until the end of 1925 will the whole of the electrification system be in full working order.

THE report of Colonel Pringle on the fatal collision of April 26th outside Euston Station stated that the total number of passenger vehicles on the London, Midland and Scottish Railway was 22,581, of which 8160, or 36 per cent., were lighted by electricity and the remainder by gas. On the former London and North-Western there were 4358, or 49 per cent. lighted electrically and 4633 by gas. In 1912 the percentage electrically lighted was 33. The policy of the London, Midland and Scottish Railway is to light all new stock by electricity, and gas is dispensed with as vehicles are renewed. All gas-lighted vehicles on the London and North-Western section have back pressure valves fitted to the gas cylinders, so that if the high pressure pipe is severed the back pressure valve acts to prevent gas escaping at high pressure.

SPEAKING at the first annual meeting of the Great Eastern Train Ferries on the 4th inst., the chairman said that from April 24th to the end of August nearly 1200 wagons had used the train ferry. In practically every case consigners who had sent shipments had continued to do so and in increased quantities. The company has acquired wagons suitable for special export traffic, such as boilers, big castings and the like. It will be a great advantage when manufacturers can load up for export orders heavy machinery on trucks, at, say, Leeds or Sheffield for delivery from the same trucks at, say, Warsaw or Milan. The great argument in favour of a Channel Tunnel was the elimination thereby of all need for transhipment of goods from truck to ship at the English port and from ship to truck at the foreign port. This advantage the ferry service affords.

WORK on the development of the system of railways in Norrland, in the northern part of Sweden, is being rapidly pushed forward, as that part of the country possesses extremely rich resources in timber, ores, water power, &c., while railways have hitherto been few in number. In addition to the main line traversing the whole of Norrland at a distance of 25 to 125 kiloms. from the coast, with branches radiating to coast centres and Norway, a large inland line is under construction running from Sveg in the south to Gaellivare in the north. A large part of this line has already been completed, and a new section, Sveg-Hede, was to have been opened on September 1st, while work is being continued on the Porjus-Jocknock section. Transverse lines uniting the inland railway with the old main line are, in addition, being constructed; the Forsmo-Hoting line is approaching completion, and the Joern-Gubblijaure section, which runs through the recently discovered rich copper ore and pyrites areas, is just being begun. Finally, the construction of the new line following the north Swedish coast, the so-called East Coast Railway, is proceeding, and the section between Sundsvall and Hernoes will soon be completed.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first seven months of the present year has been as follows, the figures for the corresponding period of 1923 and 1922 being added in brackets:—Locomotives, £1,339,245 (£1,762,708, £3,054,709); rails, £1,034,309 (£1,417,660, £1,585,639); carriages, £654,282 (£651,247, £952,377); wagons, £2,107,560 (£1,804,200, £2,108,953); wheels and axles, £379,551 (593,192, £847,199); tires and axles, £379,515 (£304,851, £266,472); chairs and metal sleepers, £842,221 (£525,567, £142,284); miscellaneous permanant way, £709,127 (£656,286, £894,559); total permanent way, £3,479,186 (£3,680,611, £5,144,075). The weight of the rails exported was 114,744 tons (158,271 tons, 154,287 tons), and of the chairs and metal sleepers, 67,251 tons (46,732 tons, 101,465 tons). During the month of July last locomotives of the following values were shipped to the countries named:—The Argentine, £133,433; South Africa, £29,099; India, £25,820; Australia, £3908; and certain "other countries," £24,395. Also rails as follows:—The Argentine, £20,337; New Zealand, £8878; South Africa, £6999; India, £6974; Australia, £6053; British East Africa, £2311; and certain "other countries," £59,845.

Notes and Memoranda.

WHAT is claimed to be the largest wooden dummy, or fender, for quayside work has just been completed at Southampton. It is to be used for holding the United States liner Leviathian off berth No. 41 at Southampton, and measures 49ft. in length, 61ft. wide at one end, and 20ft. at the other, while its depth is 15ft. 2in. It was designed and built by the Southern Railway Company.

ACCORDING to the *Chemical Trade Journal* the Committee for the Standardisation of Scientific Glassware has decided that the cubic centimetre must be discarded, as one thousand c.c.s., measured on the assumption that the weight of one cubic centimetre of water is one gramme, are really equal in volume to 1.002 litres. The new unit which is to succeed the cubic centimetre is to be called the millilitre, and will really be the one-thousandth part by volume of the standard metric litre

WHAT is claimed to be the largest storage battery locomotive yet built in the United States has recently been put in commission at the Schenectady plant of the General Electric Company. This locomotive weighs 75 tons, and is a double bogie, four-motor unit with a central cab and batteries arranged in compartments at both ends. It is equipped with contactor controller and automatic air brake. The storage battery, which consists of 100 cells, has a total capacity of 1080 ampère-hours or 216 kilowatt-hours.

THE Society of German Engineers in co-operation with the German State Railways are making arrangements for holding an exhibition of railway material from September 21st to October 5th at Seddin Station, which is within easy run of Berlin. The exhibits will include locomotives, motor trucks, carriages and wagons, signalling and train sorting apparatus, permanent-way materials, machine tools, &c. Simultaneously an exhibition of models, plans and drawings, &c., will be held at the Technical High School, Seddin.

ACCORDING to *The Ironmonger*, Mr. J. A. Potter, of Sheffield, who is connected with the Tenter Foundry Company (Limited), of Rotherham, has submitted to the Ministry of Health a plan for erecting dwelling houses of cast iron plates, coated externally with concrete, and plastered inside. He calculates that a pair of such houses each consisting of a parlour, large kitchen, three bedrooms, attic, bathroom, and lavatory, could be constructed at a cost of £550—without land and drains—and is arranging for six to be erected as an experiment at Rotherham. The exterior walls will be 5½in. thick, with a cavity.

ACCORDING to Special Statistical Bulletin No. 4, 1924, issued by the American Iron and Steel Institute, the pig iron output of the United States during the first half of the current year was only 17,514,485 tons of 2240 lb., as compared with 21,016,475 tons in the first six months of 1923, including spiegeleisen and ferro-alloys in both years. Of this year's output 107,792 tons were charcoal iron and the rest—17,406,693 tons—pricipally coke iron, including pig iron and ferro-alloys made in the electric furnace with and without coke. On June 30th last there were only 164 furnaces in blast—out of 427 extant—as compared with 239 in blast on December 31st, 1923.

THE wire gauze used in miners' flame safety lamps has remained unchanged in mesh from Sir Humphey Davy's time up to the present day. Recently, however, the Miners' Lamps Committee reported to the Secretary for Mines that, so long as two gauzes are used, a more open gauze might safely be employed, thus improving the light-giving power of these lamps. The Secretary for Mines accordingly arranged with the co-operation of leading manufacturers of flame safety lamps for comparative tests to be carried out at the Mines Department Lamp Testing Station of (*a*) lamps fitted with the present standard gauzes—28 meshes to the linear inch; and (*b*) similar lamps fitted with gauzes having 20 meshes to the linear inch. By direction of the Secretary for Mines the Superintending Testing Officer's Report on these tests has now been printed and published by H.M. Stationery Office. The report fully confirms the views of the Miners' Lamps Committee.

SOME experiments have recently been made in a New Mexico colliery, according to the *Iron and Coal Trades Review*, on the use of a cement gun for stone dusting. Instead of a batch of concrete, the apparatus, stationed at the intake end of the main entry, ejects a stream of fine, dry shale dust into a strong ventilating current. The shale dust was discharged at the rate of a ton per hour. The velocity of the air current in one test was 800 to 1000 lineal feet per minute at the intake, and about 400 lineal feet at a distance of 6000ft. The dust cloud at this point was dense for a period of 25 minutes after the cement gun was started; and definite evidence of dust settlement was found as far as 9000ft. from the gun. To get an even distribution of dust through an entry, it would be necessary to shift the machine from time to time, and in order to obtain a deposit of, say, 4 lb. per lineal foot in an entry 98 square feet in cross section and 6000ft. long, it would be necessary to distribute a ton of dust per hour for 12 hours.

ONE of the oldest and best known of the Hong Kong industries is the manufacture of vermilion, which is used by the Chinese for making varnishes, for colouring candles and paper, and for stamping and writing purposes. The annual output in Hong Kong, says the United States Consul there, is estimated to be about 20,000 cases of 50 catties each (66⅔ lb.) the total value being approximately 1,800,000 Hong Kong dollars. Of the total output of 20,000 cases, about 10 per cent. is for local use, 10 per cent. for exportation to the United States and Europe, and 80 per cent. for exportation to Canton, Fatshan, and the neighbouring districts. The exports to the United States and Europe are small in consequence of the competition of coal-tar dyes, which are much cheaper. There is only one grade of Chinese vermilion, made of a mixture of mercury and red sulphur in the proportion of 100 to 90; that is, 100 lb. of mercury to 90 lb. of red sulphur. The red sulphur employed is secured from the Provinces of South China.

Miscellanea.

A LARGE flow of natural gas has been tapped by the Dominion Alloy Steel Corporation on its works at Sarnia, Ontario, while drilling for water.

THE Corporation of Durban, South Africa, is contemplating a public works programme, which will involve the expenditure of nearly £2,000,000,

AN explosives factory, for manufacturing smokeless powder and dynamite for industrial purposes, is to be erected at the Sincheng Arsenal, Shantung, China, at a cost of some £10,000.

AT the present time about a dozen new telephone exchanges are being constructed, while some thirty others are being built throughout the country. Several large new Post Offices are also being put up.

THE Birmingham Chamber of Commerce has decided to organise again the International Foundry Trades Exhibition in 1926, upon the same lines as the previous two successful Exhibitions held in 1922 and 1924.

THERE has just been published by his Majesty's Stationery Office a "List of Quarries in Great Britain and the Isle of Man." It includes a general index, an index of owners and a mineral index. The price is 35s. net.

IT is proposed to extend the water front of San Francisco 20 miles beyond its present limits, and in connection therewith, to dredge a deep water ship canal, 50 miles long, from Hunter's Point, in San Francisco, to Ravenswood in San Marco country.

IT is reported that a series of seven big wireless stations is to be erected in this country, and on the Continent which, by working in conjunction, will be able to direct the navigation of aircraft along any porton of the Western European airways even when the pilot is unable to distinguish any landmarks.

TWO new asbestos mills are to be built by Asbestos Mills, Limited, Montreal, to handle asbestos rock by the new selective treatment from the Black Lake and Asbestos Mines properties. Mr. G. L. Barland, consulting engineer estimates the reasonably assured ore at the Asbestos Mines Property at 2,000,000 tons.

THE scheme for making Nottingham a port is now practically completed. Three locks have all been finished, only two weirs and dredging work remaining. The whole will be inspected this month by the Ministry of Labour, and then, it is anticipated, 100-ton steamers will make the through journey to Hull and thence into the North Sea.

ALTHOUGH the greater part of the old ironworks of Cochrane and Co., at Dudley, which have been closed for some time, are to be demolished, it is intended, so we understand, to preserve the furnaces in the cast iron pipe department and the general foundry in the hope that there may be a revival in the iron trade to justify restarting the works.

THE coal output at the mines of Great Britain for the week ended August 16th was 5,193,100 tons, as compared with 3,446,100 tons for the previous week, and 5,124,000 tons for the corresponding week of last year. The output at the mines of Scotland for the week ended August 16th was 136,800 tons, as compared with 135,900 tons for the preceding week. During the week ended August 16th there were 1,170,200 wage earners employed at the mines of Great Britain.

IN view of complaints which have reached the Minister of Transport regarding the slipperiness of certain kinds of road surfaces in some state of the weather, the Minister recently invited representatives of the principal firms associated with these types of paving to meet officers of the Roads Department for a general discussion of the question. As a result of this meeting a small committee has been set up, on which the Roads Department is represented, to undertake immediate investigations and experiments which it is hoped will lead to a solution of the difficulty.

THE work of salving the 24 scuttled German torpedo-destroyers at Scapa is proceeding with remarkable regularity. The first destroyer was raised on August 1st, the second on August 13th, and the third on August 29th, with a slight delay caused by bad weather; while the fourth is just about to be brought to the surface. The report referred to in our last week's note in this column, namely, that Cox and Danks, Limited, had purchased the foreign floating dry dock lying in the Gare Loch is, we learn, unfounded. The firm, we understand, finds that its present destroyer salving equipment is of ample capacity for the work in hand.

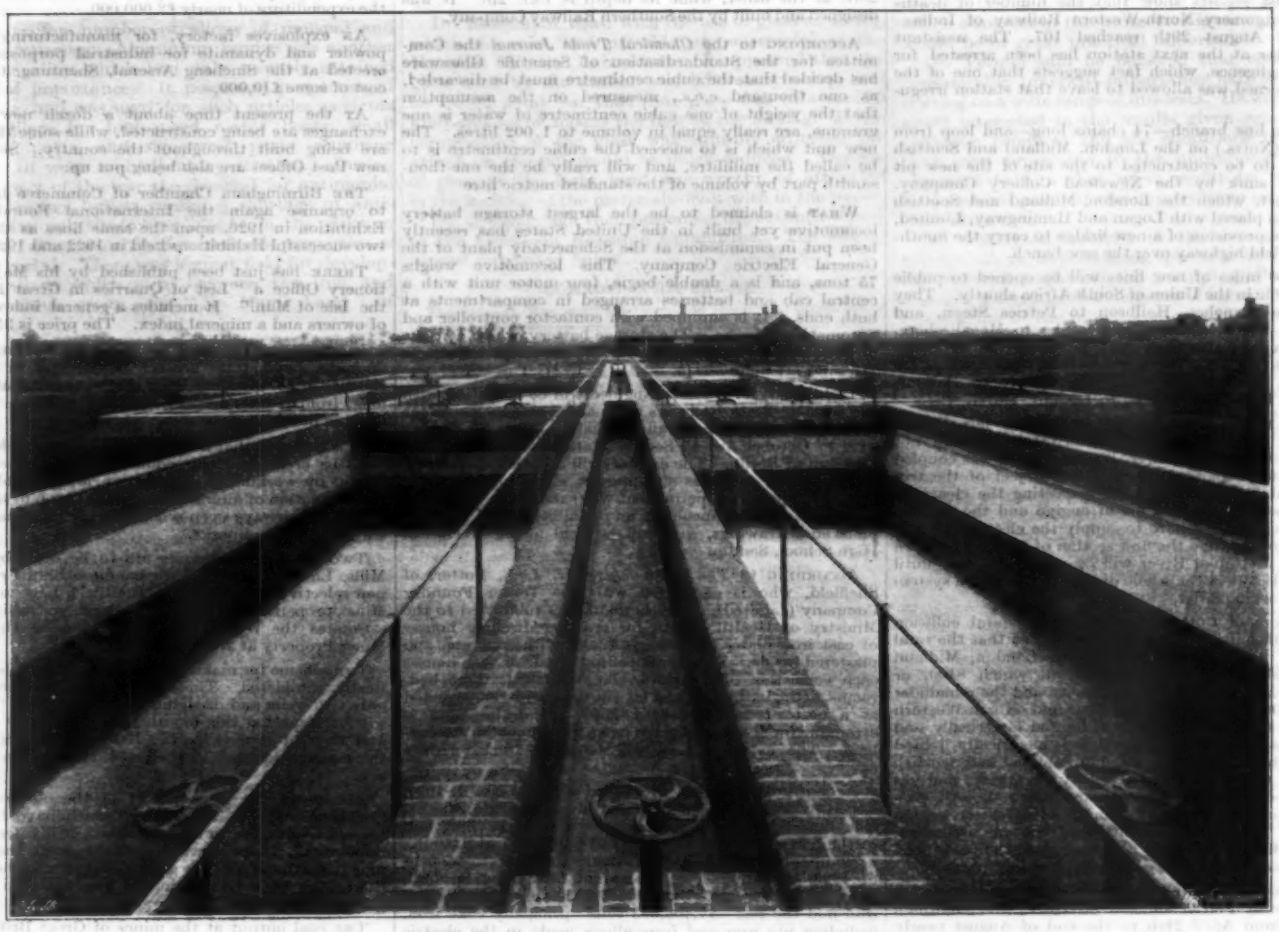
SPEAKING in the Australian House of Representatives on Friday of last week, September 5th, Mr. Bruce said that in view of the inability to form a reliable estimate of the cost of construction of the two 10,000-ton cruisers designed to replace the Melbourne and Sydney, the Federal Government had decided to invite tenders, both from England and Australia. The English tenderers would be asked to offer for:—(1) The construction of one cruiser to be built in British yards; (2) the construction of both cruisers in Great Britain; and (3) the construction of one in Great Britain and one in Australia. Mr. Bruce stated that the Admiralty would be asked to make the necessary plans and specification available for the High Commissioner immediately.

THE Canadian section of the Joint Engineering Board, to which has been referred a number of questions regarding the St. Lawrence waterways project, is at work making surveys and borings and gathering information for use in the preparation of plans which may form the basis of a treaty between Canada and the United States. It is stated at Ottawa that work under the United States section of the Board will probably begin in October. One of the points to be determined is whether or not the construction of the waterway would materially affect the levels of the St. Lawrence River at points below the Canal. The general effect of the undertaking on the whole country will be determined by the National Advisory Committee with the assistance of the Engineering Board.

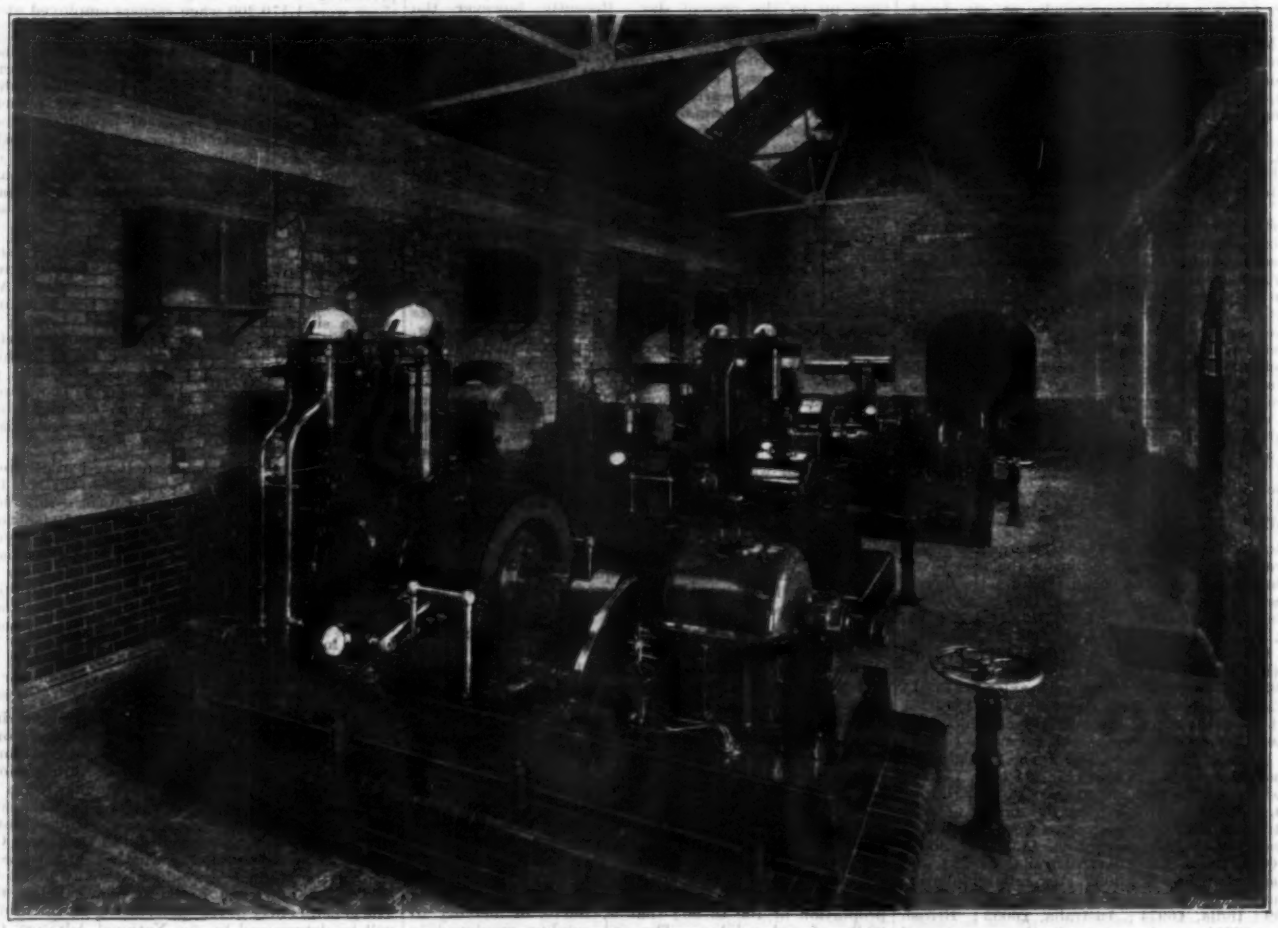
RIVERSIDE SEWAGE DISPOSAL WORKS, RAINHAM

MR. WILLIAM FAIRLEY, M. Inst. C.E., WESTMINSTER, ENGINEER

(For description see page 290)



TIDAL STORAGE AND SEWAGE SEDIMENTATION TANKS



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SIXTEEN-PAGE SPECIAL SUPPLEMENT—BRITISH MACHINE TOOLS AT THE OLYMPIA EXHIBITION.

THE ENGINEER.

SEPTEMBER 12, 1924.

The Efficiency of Electric Power Stations.

THE fourth annual report of the Electricity Commissioners and a publication on the generation of electricity in Great Britain have just been issued. Both publications are obtainable from his Majesty's Stationery Office. Of the two, the last-named is undoubtedly the more interesting to power station engineers. As those who are associated with the electricity supply business are well aware, it contains analyses and summaries of the returns of fuel consumption and units generated, made to the Electricity Commissioners by authorised undertakers under the provisions of Section 27 of the Electricity (Supply) Act, 1919, and of the returns furnished by railway and tramway authorities and by certain non-statutory undertakings. Previous issues of the publications have done a great deal of good, for they have shown what can be accomplished under given conditions and have aroused a greater desire on the part of those in charge of generating stations to reduce the fuel consumption and to raise the thermal efficiency to a reasonable level. The installation of more economical plant in existing stations in various parts of the country and the establishment of entirely new stations, equipped with the most modern machinery, have, however, been the main factors contributing towards the improved results that have been secured within recent years. But, as the report shows, there are still stations that have very much to be desired and which ought to be abolished or reconstructed at the earliest opportunity. During the period covered, returns were received in respect of 541 generating stations representing an increase of 9 on the figures for the previous year, and 450 stations have been given places in order of merit based on thermal efficiency—in comparison with stations of the same group and class in their respective areas and also in Great Britain. The remaining 91 stations were either inoperative during a greater part of the year or the power which they produced was generated entirely or mainly by waste heat.

There are still central station engineers who are without means of testing the calorific value of their fuel, for the report states that, following the practice of last year, in cases where individual returns did not specify calorific value of the coal used the figures taken by the Commissioners for calculating the approximate thermal efficiency was the average calorific value of the same class of fuel used at all other stations for which the figures were submitted. That some engineers should still be in the dark as regards the actual calorific value of the coal they use is, to say the least, unsatisfactory, both from the point of view of the supply undertakings themselves and the Electricity Commissioners. The methods of fuel testing may, it is true, leave something to be desired, yet it is remarkable that even some of the important stations are still without exact knowledge of the calorific value of the fuel they consume. But apart from that defect, the Commissioners have no reason for complaint. As compared with the corresponding figures for the preceding year, the total output showed an increase of nearly 943 million units, or 16.4 per cent., whereas the total consumption of fuel only showed an increase of 772,157 tons, or 11.3 per cent. The average consumption of fuel at steam stations was reduced from 2.78 lb. to 2.67 lb. per unit generated, a saving of 4 per cent., whilst at oil stations the consumption fell from 1.72 lb. to 1.49 lb., representing a saving of 13.3 per cent., and at gas producer stations from 2.7 lb. to 2.63 lb., or 2.6 per cent. The Barton station of the Manchester Corporation, which began operations on October 11th, 1923, and which was described in our issue of October 12th of that year, shows the highest thermal efficiency, namely, 20.33 per cent., the consumption of coal per unit being only 1.48 lb. The North Tees station, which works at a higher steam pressure, namely, 450 lb. per square inch, as compared with 375 lb. at Barton, only shows at present a thermal efficiency of 17.6 per cent.; but, as was explained in our issue of June 13th of this year, tests that have been carried out on the plant indicate that the expected weekly operating efficiency of 21 per cent. will be secured when the industrial conditions improve and give rise to a reasonable load on the generating sets during the night and week-ends. In the design of this station great efforts have been made to secure economical results, yet a thermal efficiency of 21 per cent. or thereabouts is apparently all that is expected. The very remarkable improvement in the efficiency of oil engine driven stations cannot be allowed to pass without observation. The best steam stations have only succeeded in attaining a thermal efficiency approaching 21 per cent., whereas the best oil station shows an efficiency of over 29 per cent., and the average improvement for forty-seven such stations amounts to no less than 13.3 per cent., as compared with the last returns. The stations are, of course, relatively small, the fuel is more costly than coal, and the cost per unit is therefore greater, but the efficiencies are so high that the position occupied by such stations cannot be lightly regarded. In this connection it would be instructive if the Commissioners could add to their valuable tables a column showing the average cost of fuel per unit generated.

Sooner or later scientists and engineers will no doubt discover that the present method of generating electricity is altogether incorrect; but in the meantime the value of the work that the Electricity Commissioners are doing in the way of publishing these statistics relative to the operation of steam, gas, and oil stations must not on any account be under-rated. Until a better method is found, everything that tends to raise the efficiency of steam and internal combustion engine stations must obviously be encouraged. Yet it is to be hoped that the slow but steady rise in thermal efficiencies will not cause scientists and engineers to lose sight of the possibility of introducing other methods. Occasionally someone who sees the great imperfections of the present system raises a cry for research with a view to finding another system. For the most part, however, engineers cannot even think of anything beyond the heat engine, which, with all its improvements and modifications, is still a very inefficient machine for producing electricity. Not many weeks ago we had occasion to refer to Mr. Campbell Swinton's idea of deriving electrical energy direct from the rays of the sun. That may seem to some a wild and impracticable scheme, far removed from the field of practical electrical engineering, yet if we consider the early and delicate experiments of Faraday and to what they have now led, it will be realised that Mr. Swinton's suggestion must not be hastily dismissed. It is for the scientist to pave the way for a new method of generating electricity, rather than the engineer, who after all is only the man who designs and makes machines. As Sir J. J. Thomson remarked in the course of a speech delivered some time ago, when the scientist puts forward something new, engineers are not slow in making use of it, and he mentioned the thermionic valve as a case in point. Research with a view to finding an entirely new way of obtaining electricity is every bit as important as endeavouring to discover means of improving the efficiency

of the existing method, which still remains and, as far as can be seen, will always remain, very imperfect.

Thames Water-buses.

It is often said that the Thames is not to Londoners what the Seine is to Parisians. In a large measure that is true. Few Londoners have any affection for their river and very little pride in it. It is looked upon as a trade highway laid out on a rather inconvenient route and causing, by the necessity of crossing it, great trouble and expense. Our indifference to it is reflected in the fact that there is across it only one bridge of which we are really proud as an architectural work, the remaining dozen or so being regarded, in most cases with justice, as nothing more than necessary physical connections between the two banks. It is reflected, also, in the fact that Londoners refuse to use the Thames as a passenger highway, although the relief that it might give to our congested roads and railways is well recognised. It flows through the busiest part of the city, more than a score of railway stations stand beside it, and tramways and omnibus routes run along its banks. It is wide enough to admit of a copious stream of traffic without interruption, and is readily accessible at nearly all points. That it could be advantageously employed for passenger traffic is never denied; that it will have to be so employed if the congestion of trains, omnibuses and trams continue to augment is becoming more and more evident. In these circumstances the scheme just placed before the public by Sir Samuel Instone is of particular interest. Sir Samuel proposes to establish upon the Thames of London a service of fast motor boats between South Woolwich and Hammersmith. The boats would carry 300 passengers apiece, fares would not exceed a penny per mile, calls would be made at twenty-five landing stages, and for distances exceeding two miles the river service would be quicker than omnibus service.

It is impossible to think of Thames passenger traffic without recalling the disastrous experience of the London County Council nearly twenty years ago. The London Steamboat Company had made a measure of success with Thames steamer traffic. It carried, it is said, some twenty million passengers per annum over an average of ten years, and in 1901 had a fleet of thirty-six steamers. The London County Council, fascinated by the apparent success of this enterprise ordered thirty paddle steamers, fitted with inclined compound engines and capable of carrying in all five hundred passengers apiece. The service was opened by a stately water procession on June 17th, 1905. But the public could not be induced to use the steamers, and many of our readers will recall a banner which appeared in a County Council election and which bore the damning legend "One man, one boat." In February, 1908, a disastrous report was presented to the Council. The deficit on the service amounted to over one hundred and thirty-seven thousand pounds and a debt of a quarter of a million pounds remained to be paid off. In the face of that report the Council decided to withdraw the boats and cut the losses. The blow was a serious one to municipal enterprise, whose supporters were forced to seek some comfort in the fact that the County Council itself was responsible for the failure, since tramways along the Embankment, opened about the same time, attracted the public which should have gone to the steamers. This balm was, however, sadly diluted by the fact that the tramways themselves were also unprofitable. In the face of this example we may well ask ourselves if Sir Samuel Instone's scheme is likely to succeed. Much change has taken place in London in the past twenty years, and so great is the pressure upon locomotion by land that it is at least conceivable that the opportunity for the Thames has come once more. Moreover, the motor boat presents advantages that steamers lack. Yet one can by no means be certain that the public will now be any more anxious to seek the Thames in the grey days of autumn and winter than it was a score of years ago. How much easier to step into a tram, an omnibus, or a train than to wait on an exposed and unattractive pier for a motor boat! That has always been the obstacle to Thames passenger traffic, and we fear it is not likely to be overcome even by the pressure and congestion of street and tube transport. Nor are we satisfied that the vessels which Sir Samuel Instone proposes to employ are the most likely to attract any passengers save those who are under the misconception that they are embarking on a pleasure trip. We cannot, for example, understand why a dining saloon and buffet should be provided. We do not look for such amenities on suburban trains, or upon trams or omnibuses, and we find it difficult to believe that the busy City man or the dweller in Hammersmith or Woolwich will, following the example of predecessors on the river,

> "Set out with their hearts so light, gay and merry,
> Regaling themselves with beer, beef and sherry."

In this respect it seems that tradition has been allowed to influence opinion. We suggest that Sir Samuel would be well advised to break away from the past altogether. There is no reason whatever why the vessels should even be shipshape above water. The object should be to produce "water-buses" to compete with motor-buses. All resemblance between the omnibus and its predecessor, the coach, has disappeared; why any resemblance between the water-bus and a steamboat should be retained we fail to see. It is the "pleasure trip" aspect of Sir Samuel's scheme which has probably led to the design, but it is the business aspect of the boats upon which their success must depend. The construction of the landing stages and piers will also demand greater attention. They now smack too much of salt water and tar. The Thames as a London highway will be very different from the Thames as a river. The river itself will be no more to the daily passenger to and from business than is the permanent way of the Underground. He will not use it on account of the view or the salubrious air, but to get from place to place, and will be far more interested in his daily paper than the pictures presented by the Thames and its traffic.

So much has happened since the failure of the County Council steamers that it is quite impossible to say what prospect of success is open to the Instone boats. Yet we hope to see the experiment made, and we hope to see it profitable. A private venture of this kind is to be encouraged, and incidentally is far more likely to meet with success than a municipal one. Every Londoner desires to see the Thames revived as a highway, not only because the charm of London to visitors would be increased thereby, but because anything that tends to reduce the density of traffic along metropolitan highways is something to the good. The time is approaching when such an admirable highway as the river presents must once more be as fully employed as it was in the days of our forefathers; but we submit that any illusions as to the charm of the river to busy travellers must be got rid of. What the public wants is means of comfortable communication, and it will ask for accommodation on board equivalent to that to which it is accustomed ashore, and for landing stages which in some reasonable measure will resemble railway stations. If it does not get these things we doubt if anything save the finest weather will tempt it to leave the highways, and the unfortunate experience of earlier ventures, which saw the bulk of the boats laid up for seven months out of the twelve, will be repeated.

Iron and Steel Institute.

No. I.

The autumn Conference of the Iron and Steel Institute was held at the British Empire Exhibition on September 4th and 5th, under the presidency of Sir William Ellis.

The President, in opening the proceedings, said that although the main function of the Institute was to study the technical side of the iron and steel industry, it was impossible in a gathering of the kind assembled, including those responsible for the operation of great businesses, to disregard the serious position with which they were faced to-day. There never was a period when the technical knowledge of members could be placed at the disposal of the industry to better effect than at the present time. The ironmasters of other countries had been able to spend more money on new plant and in renewing works equipment than British manufacturers, who were struggling with economic difficulties as well as with conditions of severe financial stringency. Yet whatever the monetary difficulties, and they would tend to increase rather than diminish, it was necessary to impress on those responsible for the management of British iron and steel works the essential need of keeping their plant and equipment in line with the most modern practice. Great Britain was fighting for its life in certain industries, and to enable the British iron and steel trades to withstand the stress of foreign competition the cost of adopting the latest labour-saving appliances and fuel economy devices must be faced. He desired to put forward a plea to the steel makers and maintenance engineers who were, day by day, carrying on manufacturing processes and were responsible for administration, and who could not, therefore, keep in touch with the latest scientific developments, that they would utilise the knowledge of the younger men. Many of the latter had had a sound training on the technical side and could suggest how economies in manufacturing costs could be realised. It must be admitted that steel makers generally had hitherto failed to make the best use of the rising generation of metallurgists and engineers. The spade work should be done by the younger men who had been given a modern educational equipment and were in close touch with modern ideas.

It was announced that Sir Frederick Mills had been elected to succeed Sir William Ellis as president of the Institute. Professor H. le Chatelier, Mr. W. H. Hewlett, Mr. E. Steer, and Mr. C. J. Bagley have been elected honorary vice-presidents, and Sir Charles Wright, Mr. F. W. Harbord, and Mr. W. R. Lysaght ordinary vice-presidents. To fill the vacancies on the Council caused by the election of new vice-presidents, Professor C. H. Desch, Captain Valentine Beardmore Stewart and Mr. W. Simons have been appointed.

The first paper presented was that by Professor C. A. Edwards on "Pickling; or the Action of Acid Solutions on Mild Steel and the Diffusion of Hydrogen through the Metal," of which an abstract was given by the author.

PICKLING.

As is well known, the oxide of iron which is formed on the surface of steel during hot rolling, &c., has to be completely removed before the metal can be satisfactorily covered with a superficial coating of tin, zinc, or enamel. This is because it is essential to have a perfectly clean metallic surface before tin or zinc will unite with the steel, or enamel can form an adherent coating upon it. In the trades the operation in which this cleaning is performed is known as "pickling." The steel is immersed in aqueous solutions of sulphuric or hydrochloric acid. The acidity of the solutions used varies within wide limits, and depends upon the amount of oxide which has to be removed, and to some extent upon the nature of the coating it is subsequently intended to put upon the metal. The acid penetrates the more or less porous film of oxide, and on coming into contact with the underlying metal forms ferrous sulphate, or ferrous chloride, as the case may be, with the liberation of hydrogen. In spite of what some writers on this subject have said, there can be no doubt that this gas, being generated, as it is, between the metal and the oxide, is responsible for the removal of a large proportion of the oxide by mechanically detaching it from the metal before it can be dissolved by the acid. Other reactions may also take place, but for the purpose of the present paper only one need be mentioned.

In a general kind of way it has long been known that not the whole of the hydrogen generated by the action of sulphuric or hydrochloric acid upon steel freely escapes from the liquid; some is taken up—that is, absorbed—by the metal itself, and is more or less permanently retained in that condition. Further, it is recognised that when hydrogen has been absorbed by steel in this manner the metal is embrittled. Some of this embrittling can only be regarded as of a temporary character, for it can be removed by a low temperature annealing. The revival of the properties of the metal by this annealing is due to a large proportion of the absorbed hydrogen being driven out of the metal. The amount of hydrogen which can be removed in this way is governed by two factors, namely, time and temperature of annealing. The higher the temperature and the longer the time, the more complete the elimination of the hydrogen.

From the experiments described in the present paper the general conclusions that can be drawn may be briefly summarised as follows:—

(1) Cailletet's discovery that hydrogen which is being developed by acid attack upon iron and steel can enter and pass through the metal has been confirmed.

(2) The presence of an inclusion such as oxide of iron will cause the hydrogen, which enters the metal in the atomic state, to be liberated at and around the inclusion in the molecular condition. The amount of hydrogen which accumulates at such inclusions is a function of the duration of pickling, the distance of the inclusion from the surface that is being acted upon by the acid, the strength of the acid used, and the temperature; it increases with the time, temperature, and acidity, but is inversely proportional with the distance. It is believed that other impurities and constituents, such as sulphide of manganese and carbide of iron, behave in the same way as oxide of iron, but it has not yet been found possible to make reliable experiments whereby this view could be definitely tested. It has, however, been shown that collodion and enamel will cause the liberation of hydrogen which has entered iron during pickling.

(3) A simple apparatus has been devised with which it has been possible to make quantitative measurements of the rate at which hydrogen diffuses through iron and steel under varying conditions of acidity and temperature.

(a) The influence of acidity, when using sulphuric and hydrochloric acids in water, upon the rate of hydrogen diffusion has been determined.

(b) The rates of hydrogen diffusion, when using normal solutions of sulphuric acid, between 0 deg. and 100 deg. Cent., have also been determined.

(c) The effects of temperature, when using normal sulphuric acid, on the rate of solution of iron have been examined, and these have been correlated with the rates of hydrogen diffusion.

(d) It has been found that, other things being equal, the rate at which hydrogen diffuses through mild steel is inversely proportional to the thickness of the metal.

(4) When dealing with thin sheets of steel it has been found that the presence or absence of a film of oxide of iron upon the surface has a marked effect on the rate at which hydrogen passes through the metal.

(5) Experiments have been made with specimens of metal containing only one crystal in the area acted upon by the acid, and it was found that the hydrogen passed through this quite readily. Indeed, no difference in the rate of diffusion could be detected under these conditions as compared with specimens containing the usual small crystals.

(6) The diffusion of hydrogen can be prevented by electrolytic pickling and by using suitable oxidising reagents in the acid. A certain amount of work has been done in this direction, and it is now being systematically extended.

Mr. J. K. Whiteley drew attention to a piece of evidence which the author had not taken into account. If hydrogen could collect in quantities sufficient to give rise to large blisters, evidence of that could probably be obtained by microscopic examination. With regard to the embrittling action of hydrogen all those engaged in manufacturing operations knew that steel became brittle if treated with acid. He had experience of a steel plate which when sent out had a tensile strength of 27½ tons and an elongation

value of 30 per cent., but which came back in an extremely brittle condition, having then a tensile strength of 40 tons and an elongation figure of only 4 per cent. Under the microscope nothing could be seen to account for the change, but it was found that by normalising the steel the original condition could be restored. His interest was aroused and he investigated the hydrogen content which came out at .001 per cent., and even when to make sure that the whole of the hydrogen had been determined he drilled the cylinders into which the material had been cut and burned the drillings in oxygen the figure rose only to .004 per cent. That was a very small amount to cause brittleness, and he thought it was rather the passage of hydrogen through the metal than its actual presence which accounted for the extreme brittleness.

Mr. Law reminded the meeting that it was eighteen years since the subject was last discussed before the Institute. It was one of great importance to all sections of the iron and steel industry. In the tin-plate branch alone at least 2500 tons of sulphuric acid a year were employed, and the quantity of steel dissolved was something over 4000 tons. Any economy which could be effected would be of great benefit to the manufacturing trade. He could not, however, accept the author's theory without some reservation. If the hydrogen penetrated the steel until it met with some obstruction and then accumulated in a molecular form and caused blisters, that should happen in the case of other inclusions. In his opinion, and he had formed it long since, the formation of the blisters was due to the reduction of the oxide.

Mr. W. H. Ridsdale expressed the belief that it was not necessarily either the oxide or any other obstacle which caused the trouble, but simply a microscopic lamination. He had investigated the subject from the commercial standpoint and had carried out experiments under works conditions at temperatures of from 180 deg. to 200 deg. F. The sulphuric acid used had a strength of 1 in 3, except in the white pickle, for which a weaker solution was employed. One of the earliest effects noted was that pickling for too long a time would produce blisters. He was led to consider that oxidation and overheating were the causes of the trouble. In ordinary working steel was stressed as much as the material would stand, and the moment that point was reached any further treatment was apt to produce blisters. The author referred to the use of agents added to the bath as a means of preventing blistering, and for some purposes such as attacking scale or dissolving metal that was a practice which he had found useful.

Dr. W. Rosenhain welcomed this contribution to the literature of an obscure subject. He had a difficulty in understanding how the "hydrogen ion," which was the proper term to employ, found its way through the space lattices of the crystals. He could not accept the explanation that the hydrogen atoms united and accumulated at the cavities. The probable sequence of events was that certain particles present in the crystals acted as nuclei and facilitated the union of hydrogen atoms, but whether the action was mechanical or chemical it was not possible at present to determine. Blisters arising from the diffusion of hydrogen were not confined to steel. The phenomenon of gassing in copper was familiar, and the theory of the reduction of oxide by the penetration of hydrogen was well established. A similar phenomenon was found in the case of aluminium.

Dr. W. H. Hatfield said he was not convinced of the soundness of the author's theory. There were two facts which should not be overlooked. One was the embrittling of steel by the action of acids, and the other the production of blisters. It was difficult to judge the degree of embrittling as under the ordinary service test the roughening action of the acid on the steel was not eliminated. That might lead to incorrect deductions. There was one simple way of looking at the blister problem, which was that the structure of the material was strained and the imprisonment of gas under high pressure took place. That did not produce an obvious blow-hole, but did result in the formation of a blister.

Eng.-Captain G. A. Richards, speaking from long experience of both the large and small types of blisters referred to in the paper, said that the large type was probably due to blow-holes, which in the case of solid-drawn steel tubes had not welded up, and to sulphide segregation in blow-holes which had welded up. Those of the smaller or "peppery" type were probably the result of an inherent defect in the steel. In tubes these blisters appeared in certain parts of the interior, but were absent from other portions of the tube which had received exactly the same pickling and heat treatment. In a case of boiler tubes supplied to the Admiralty in which the small blisters were present in a minute form, the tubes behaved as well as non-blistered tubes when put into service. In Admiralty experience blisters in solid drawn steel tubes were very rare indeed. Regarding the embrittling effect due to pickling he recalled an instance of tubes failing under mechanical tests owing, it was believed, to overpickling before zincing. He had carried out some experiments on that point on 1¼in. by 1lin. cold drawn tubes which were close annealed, and the test pieces cut through each tube. The result showed that by pickling for periods of from 1 to 8 hours in one part of H.Cl. to 39 of water the breaking load in tons per square inch increased from 21.5 to 22.2 tons, while the elongation on 8in. fell from 36.2 to 23.8 per cent. The length of time of pickling was a more important factor than the strength of the pickle. After close annealing and before pickling the figures were 21.6 tons and 36.4 per cent.

Professor Edwards, in a short reply, to some of the points raised, said the amount of hydrogen content mentioned by Mr. Whiteley could not be regarded as small. The time factor was undoubtedly important. He could not accept the statement by Mr. Law that manganese sulphide did not give rise to blisters. That was contrary to the opinion held in the trade. Reference had been made to the use of oxidising agents, and he would like to state that he had not employed any of the patent pickling solutions. He welcomed the experimental evidence of Eng.-Captain Richards, and he was carrying out further experiments on special steels with the object of determining some of the problems to which reference had been made by Captain Richards. Sir William Ellis had suggested that electrolytic pickling would get over the trouble, but it was a question of the cost of the process, and it was doubtful whether it was economically possible to use that process for tin-plates. It would be an enormous asset to the tin-plate trade if it could be done. Not only would the iron dissolved be recovered but the quantity of acid required would be greatly reduced.

Dr. F. C. Thompson gave a brief abstract of the paper by himself and Mr. W. E. W. Millington, entitled "The Effect of Free Surfaces on the Plastic Deformation of Certain Metals."

Dr. Hanson, referring to the experimental result quoted in the paper, said that in the case of copper and nickel the figures given were quite incorrect.

Professor C. A. Edwards criticised the authors, who had not themselves carried out a single experiment. Some of the evidence they had collected was quite useless for the purpose in view. That remark applied to the quotation from Unwin, and with regard to the evidence from tin sheets the less said about it the better. The theory was no doubt interesting, but the evidence in support of it quite unsatisfactory.

Dr. W. H. Hatfield expressed concurrence with the criticism of Professor Edwards. The evidence quoted could not be taken seriously.

Dr. Thompson said that if the results quoted were examined in a fair spirit the criticisms made were not justified.

Literature.

The Principles of Irrigation Engineering. With Special Reference to South Africa. Based on a course of Lectures delivered at the University of Cape Town. By FRANCIS EDGAR KANTHACK, C.M.G., M. Inst. C.E., M.I. Mech. E., lately Director of Irrigation for the Union of South Africa. London: Longmans, Green and Co. 1924. Price 30s. net.

IN the wide field of irrigation no book of ordinary size can be a success unless it be rigorously restricted to certain parts or to some aspects only of the subject. In the present case, the author hardly touches on designing, though he carefully considers the principles on which the designing of works is based. A chapter of twelve pages on Irrigation Law represents the space definitely allotted to administration and the human element, though both subjects have usefully guided the treatment of several matters. The author has therefore been able, in his 290 pages of text, including thirty-three tables, and with thirty-one illustrations, to deal adequately with the main elements of irrigation; the data, the deductions, and the applications. A valuable feature of the book is the presentment of a large amount of South African data. It deals with each of the principal groups of natural conditions which govern the storage and distribution of irrigation water, and explains how the problems which confront the irrigation engineer are tackled. The author's restraint in his choice of matter is justified, and its effect enhanced, by his good judgment in apportioning his space, and his decision to exclude a good deal of information, such as hydraulic data, which can readily be found elsewhere. It has therefore been possible in one volume of ordinary dimensions to present the facts on which irrigation depends, to explain their significance and to describe the processes of thought and action which are proper to irrigation engineering. A distinguishing feature of the work is that it deals with storage irrigation, and not with the problems which arise when the water is derived from perennial rivers, though the subject of silt-arresting headworks is carefully dealt with.

A useful introduction of seventeen pages, mainly devoted to rainfall, is followed by a chapter on Rainfall in South Africa, twenty-six pages, with excellent maps. The subject of Run-off, forty-four pages, is discussed much more fully than is usual in books on irrigation, and very usefully. The chapter on High Floods, Disposal of Surplus Water and Protection Against Floods is a little disappointing, in that the author does not deal adequately with the direct computation of floods from rainfall, though noting that the principle of the "period of total contribution" was recognised by Chamier in 1891, and that it was later proposed to calculate floods from the period of total contribution, the maximum rainfall for that period, and the percentage run-off. The author refers this proposal to a date in 1922, though it had been made eleven years earlier. Reservoirs and Canal Losses are discussed in the next chapter, which is followed by one on the Conservation of Water, fifty-nine pages, including a discussion of the principles governing the choice of reservoir sites, the proving of sites for dams, and the elements of the design of dams. There is also a brief discussion of arched dams and a very brief discussion of multiple arch dams. The subject of Silt is very well presented, thirty-five pages, and the same may be said of Duty of Water and Canal Capacities. A chapter on Distribution is followed by one Irrigation and Brak, short but much to the point, and the volume concludes with Irrigation Law, as applying to South Africa. The book is well written and is a sound and valuable work.

The Elements of Railroad Engineering. By WILLIAM G. RAYMOND, LL.D., Eng.D., M. Am. Soc. C.E., Member of the American Railroad Association, Professor of Civil Engineering and Dean of the College of Applied Science in the State University of Iowa. Fourth edition, revised. 1923. London: Chapman and Hall, Limited. Price 22s. 6d. net.

THE author's object, as expressed in his preface to the first edition of this work (1908), was "to describe the fixed portion of a railroad plant and to give the underlying principles of the design of its lay-out." In the second edition (1913) the chapter on train resistance was revised and, together with the portions relating to curve resistance and "rise and fall," was re-written. Matters which received similar attention in the third (1917) edition included signalling, and engine capacity, and, for the present edition, besides some other revisions, the chapter on rails has been practically re-written. The work contains some fourteen plates, including a condensed map and profile to accompany a chief engineer's report, and over 100 figures, including diagrams, scale drawings, curve showing physical relations, and a few plates, in addition to those so classed. The author's judgment as to when and how to appeal directly to the eye is very good. Mr. Raymond deals at about equal length with permanent way and with the locomotive and its work, these two main heads accounting for more than half the book. He considers surveys under the three heads—location, construction and betterment. The Appendix consists mainly of a paper and discussion relating to a particular survey.

In this useful volume the financial side of the subject receives a considerable amount of attention in the Introduction, and in the chapters on Expenditure, Operating Expense, and Valuation. Railway economics of a more strictly engineering character are prominent where the author deals with the life of rails, the durability of sleepers, spans of bridges, and estimates in the chapter on the Locomotive and Grade Problems and in that on Problems in Change of Ruling Grade, Distance, Rise and Fall, and Curvature. The work affords a good example of the value of restraint, for the author, having decided to set forth the elements of railway engineering, has rigorously excluded excursions into relevant but not essential details. He sufficiently describes the locomotive itself in about a dozen pages each of text and plates, and then fully considers the elementary and essential matter of locomotive performances, and so throughout. The relative importance of different parts of the subject is not the same in England as in the United States, but many of our young railway engineers look forward to obtaining employment in countries where the relations of railways to population and to capital are much more like what they are in Mr. Raymond's country than here, and they should find that this book would usefully extend the range of their knowledge.

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Machine Tool and Engineering Exhibition at Olympia.

No. II.*

GEORGE RICHARDS AND CO., LIMITED.

Duplex Crank Pin Turning Machine.—A new machine for the rapid production of crank shafts is exhibited by Geo. Richards and Co., Limited,

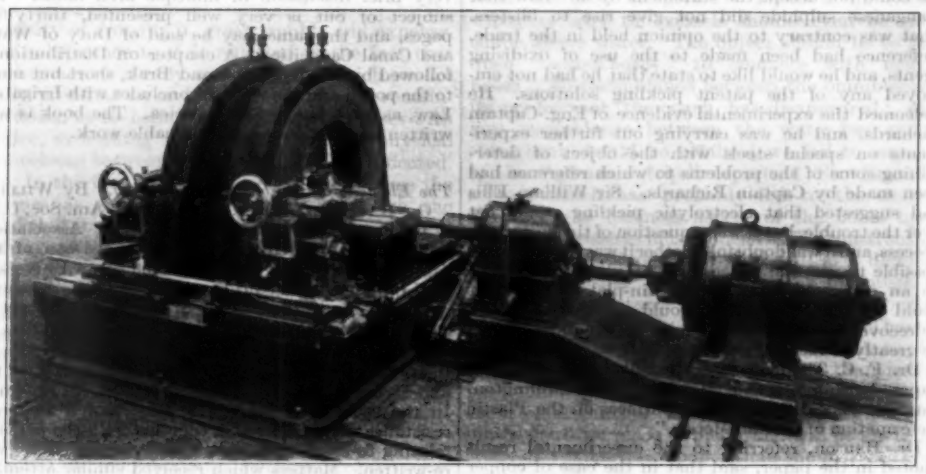


FIG. 20—DUPLEX CRANK PIN TURNING MACHINE—GEORGE RICHARDS

Broadheath, near Manchester, and some very remarkable times are being shown on the production of large cranks, in many instances a reduction in time of 50 minutes being obtained. In Fig. 20 above we illustrate this machine, as adapted for the production of automobile crank shafts, in which two crank pins are dealt with and machined simultaneously at each setting.

The bed is provided with tee slots for holding down the adjustable tables, and supports the two heads carrying the rotating cutter slides or rotors. One head is fixed and the other is adjustable longitudinally along the bed to provide for varying crank centre distances. The heads are accurately machined to receive the rotors, the thrust being taken on a vee bearing which is adjustable for wear. The slide to which a cutting tool of the former or ribbon type is attached, is operated through a screw and worm motion in the rotor, which is in turn driven by a large ring having external and internal teeth cut on the outer and inner edges respectively. The internal portion of the ring gears with a pinion on the worm shaft, and the external portion with a pinion driven from the outer periphery of the rotor through a feed-box and differential motion, the arrangement being such that the ring normally, when no feed is in operation, is driven at the same speed as the rotor. Suitable gearing is provided in the feed-box to accelerate the ring, so that a definite acceleration of speed of the ring imparts the necessary feed to the screw operating the slide. Combined with the feed-box is a differential motion, the outer member being controlled through a worm and worm wheel connected to a hand wheel, so that a hand feed can be applied to the slide when the machine is at rest or in motion. The reduction through the worm and wheel to the slide is considerable, so that very fine sizing of the pin is possible. Also contained in the feed-box is the power feed to the slide, which is arranged so as to come into operation only when the machine is at rest. The power feed is operated from the same lever as the automatic feeds in such a manner that the feeds are definitely disengaged before the power feed can be engaged. To operate the power feed the change feed lever is moved over to the end of a stop in the feed-box where a gate is formed, and in this position the lever can be raised or depressed and so operate the clutch, which engages the power feed gear. This gear consists of a double cone friction clutch driven by bevel gearing, and provides a rapid traverse to the tool slide in both directions whilst the machine is stationary. The rotors are driven through 6 to 1 reduction gearing on the main drive and through a four-speed box provided with a double friction clutch. This gearing is directly coupled to a 2 to 1 variable speed motor so that there is only one change required through a sliding gear to obtain the whole range of speeds without stopping or slowing down the machine.

The crank shaft is held in special fixtures attached to the sliding tables which are bolted to the bed. Lubrication to the cutting tool is provided by a pump drawing oil from a sump formed in the bed. The sump is covered with a perforated plate so that the cuttings can be readily removed. Provision is made on the machine for all oil to return to this sump.

* No. I. appeared Sept. 5th.

In the machining of, say, a four-throw crank shaft, the crank shaft is first rough turned on the main bearings to facilitate locating it in the table fixtures, and the two outside pins are dealt with first, the sizing of the pins being adjusted by hand. An automatic stop is then set to the size, and by means of the slipping clutch in the feed-box the sizing is maintained automatically on subsequent work. A micrometer adjustment is provided for the tool slide stop, and is graduated in thousandths of an inch. Adjustment of this automatic stop can be made to compensate for any wear of the tool. The actual time required for setting and machining one pair of pins is, we are informed, five minutes, and the work, it is claimed, is true in plane and round within a limit of accuracy of 0.0005in. To machine the inner pair of pins, the outer head is adjusted to the required centre distance, and the machining operation repeated. Though the necessity for accurate work is perhaps not quite so great in crank shafts that have to be heat treated and ground, it is undoubtedly of advantage, Messrs. Richards state, to have the pins machined true, for subsequent operations are then not required to rectify errors. One of the principal advantages claimed for the machine illustrated is the fact that there is a minimum of deflection of the work being operated upon, as a result of the crank being rigidly held on fixed tables. In addition, the fact that the crank shaft is held stationary obviates any risk of out-of-balance forces being generated, such as occur when the crank shaft is rotated.

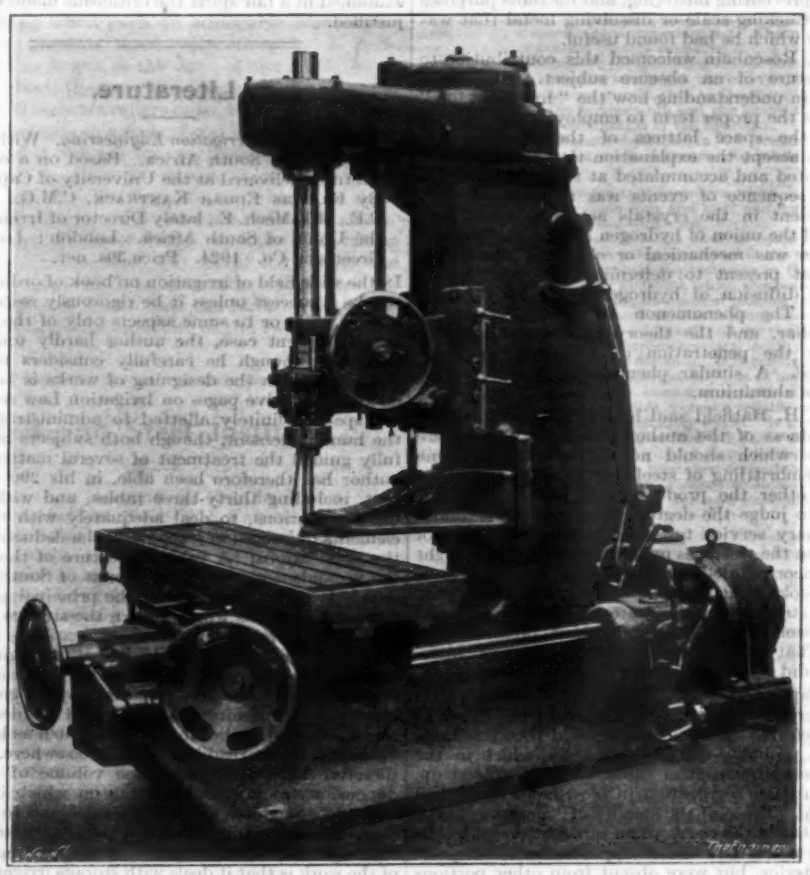


FIG. 21 VERTICAL MILLING MACHINE—KENDALL AND GENT

KENDALL AND GENT, LIMITED.

The machines exhibited by Kendall and Gent (1920) Limited, of Manchester, are principally of the milling type, although three screwing machines for bolts, tubes, &c., are also shown. The firm, as the pioneer of the plano type of heavy milling machine, recognises that no matter how efficient the machine may be, the key to satisfactory working must remain with the cutter. It has accordingly designed and constructed a form of milling cutter, of which it exhibits numerous varieties, and for which it claims the ability to produce accurate work quickly and with the minimum expenditure of power. The cutters are of the inserted blade type, the blades being made of super high-speed steel and bent to fit with exactitude into helical grooves formed in a steel body. The blades are held in position in the grooves by sweating or soldering, a method of attachment which, it is claimed, ensures rigidity and which results in the blade being held firmly at every point along its length. When the blades have been worn down almost to the body a new set can be inserted at a small cost, while, if breakages occur, a new blade may be fixed separately without disturbing the others.

Of the machines shown we illustrate what is probably the principal one in Fig. 22 opposite. This universal plano-milling machine, as it is designated, is capable of milling work up to 10ft. in length, 3ft. 6in. in width and 3ft. 6in. in height. The work is carried on a planing machine type of table, to which a feed is applied, the milling cutters being carried in saddles on the uprights and a cross slide resembling the standards and slides of a planing machine. Beyond the resemblance in appearance there is, of course, no connection between this type of machine and the planing machine, although no doubt it may be effectively used in place of the older form of machine on many classes of work. The example illustrated in our engraving has two saddles with vertical spindles on the cross slide and one saddle with a horizontal spindle on the face of the left-hand upright, a bracket for the cutter arbor being mounted on the right-hand upright. The machine is also made with one, two or four saddles. The machine is driven from a constant speed motor without the intervention of a belt. Power is transmitted to the spindles through a gear-box giving a range of spindle speeds varying from 11 to 166 revolutions per minute in 18 steps. The gear-box contains hardened steel wheels running in oil, the changes of which are effected through the agency of two handles, each having three stations, the number of changes possible being increased to eighteen by means of single and double gearing. The changes can be made while the machine is

running, and only the set of gears required to give the desired speed are in mesh at one time. A similar remark applies to the feed gearing. Nine reversible feeds are available for the table and the saddles. These feeds range from 1in. to 8in. per minute and are obtainable independently. In addition to the self-acting feeds the saddles are provided with hand

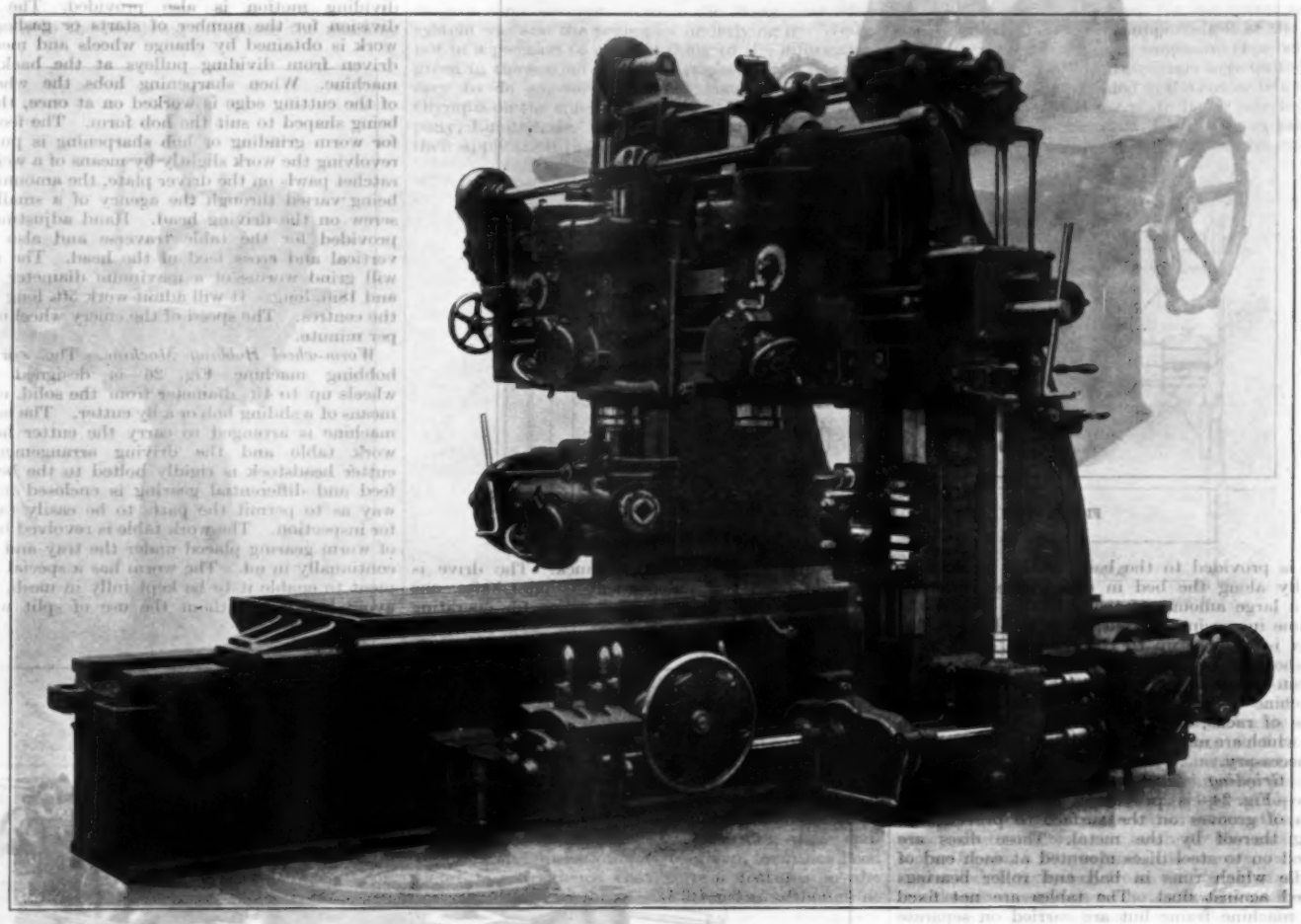


FIG. 22—UNIVERSAL PLANO-MILLING MACHINE—KENDALL AND GENT

motions and with quick power traverses for setting purposes. To facilitate the operation of the machine all the control handles on one side of the bed are duplicated on the other.

A second example of the firm's exhibits is the vertical milling machine, illustrated in Fig. 21. This machine is direct driven by an electric motor. Eighteen spindle speeds are obtainable from gearing within the column, the speeds being selected under the control of two handles, each having three stations, together with a handle controlling single or double gear working. A gear-box near the foot of the column provides a range of nine feed rates to the work table, provision being made for the transmission of these feeds either to the table itself or to the slide on which it rests, thus giving power feed in two directions at right angles to each other. The table and its slide are provided with hand motions and with quick power traverses. Automatic tripping gearing is fitted for the table feed.

JOHN HOLROYD AND CO., LIMITED.

Out of the group of machines shown by John Holroyd and Co., Limited, of Milnrow, near Rochdale, we have selected for illustration a 9in. combination turret lathe, Fig. 23; a disc grinding machine, Fig. 24; a worm grinding machine, Fig. 25; a 4ft. worm wheel hobbing machine, Fig. 26; and a revolving oil stone and general grinder, Fig. 27.

Turret Lathe.—The driving head of the turret lathe—Fig. 23—is of the all-gear type, and is driven by fast and loose pulleys 14in. diameter by 4½in. wide. There are 18 changes of spindle speed, ranging between 9 and 378 revolutions per minute. These changes are controlled by means of three levers, acting through a sliding gear and a friction and a positive clutch. All bearings and loose running wheels are bushed with phosphor bronze, the former, with the exception of the main bearings, being of the ring oiling type. The main spindle is of acid Siemens-Martin carbon steel, and is provided with a 2½in. hole. It is fitted with ball thrust washers and runs in parallel bearings of phosphor bronze, the front neck being 4½in. diameter by 6½in. long, and the back neck 3½in. diameter by 4in. long. The tail end is fitted with a 4-screw bell chuck for supporting bars. The front saddle is guided from the front shear of the bed only, which gives a long and narrow guide, thus ensuring true alignment. Full length taper gibs having end screw adjustment, take up the wear, and felt oiling pads under the saddle exclude dirt and insure lubrication. The saddle can be run close under the chuck so as not to interfere with the back saddle, while the cross slide has sufficient movement to allow the full swing of the lathe to be surfaced. A revolving tool post for four tools is mounted on a compound slide. The cross slide screw is fitted with an adjustable index disc and is provided with a ball thrust in either direction of traverse. There are six changes of power feed in both directions, viz., 8, 12, 16, 24, 32 and 48 cuts per inch, which are engaged by means of a falling worm box. The

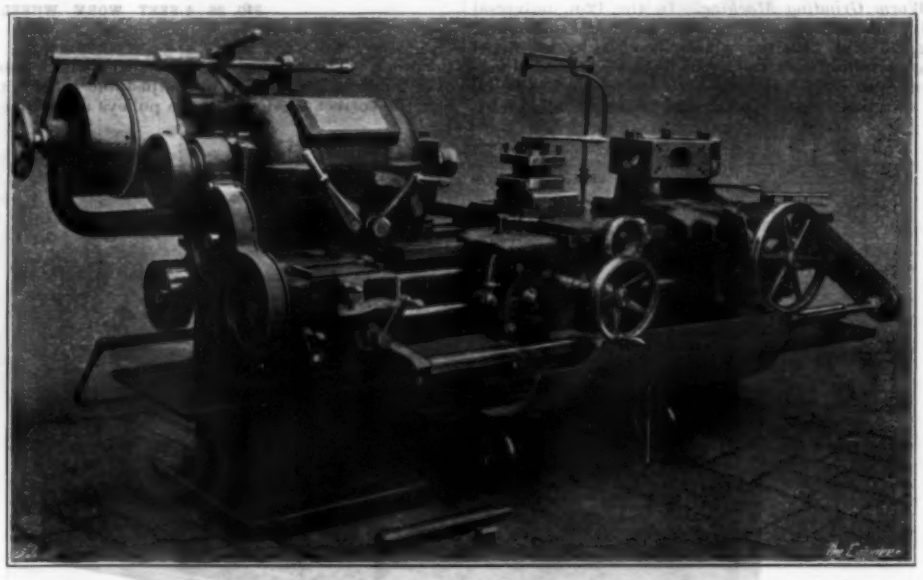


FIG. 23—COMBINATION TURRET LATHE—JOHN HOLROYD

worm, worm pinions, and worm wheel are of case hardened steel, and run in oil, the end thrust on the worm being taken by ball thrust collars. The change between longitudinal and cross traverse is effected by means of a plunger at the front of the apron. Four automatic stops are provided for each of the traverses. The chasing gear consists of a leading screw and nut, which can be changed to suit different pitches. The leader is driven through gearing in the feed-box and will cut pitches which are sub-multiplies of its own pitch in the ratio of 1, 2 and 4. The back saddle, as in the case of the front saddle, is guided on the front shear of the bed full length taper gibs with end screw adjustment taking up the wear. The locating plunger and bushes are of tool steel, hardened and ground, and a lever is provided for locking the saddle to the bed. The hexagonal turret measures 14½in. across the flats by 5½in. deep, and each face is provided with eight ⅞in. tapped holes for attaching the toolholders. The central holes are 2⅛in. diameter, and each is provided with a pad locking bolt. By means of a lever the turret can be lifted off its seatings on to ball bearings, so as to allow it to revolve very freely. The back apron is of similar design to the front apron, the plunger in this case giving an additional six feeds, making twelve changes of feed in all. Automatic stops are provided for each face of the

turret, one or more of which can be used for each face. An accurate indicator on the hand wheel enables dead lengths to be obtained. Quick power motion is provided to the back saddle for moving it rapidly along the bed in either direction, thus saving a large amount of tiring labour and at the same time increasing the output of the lathe. The feed-box is coupled up to the traverse shaft by a safety shearing coupling, the brass shearing pin of which can be quickly replaced. All gears throughout the machine are cut from steel castings, except in the case of racks, small pinions, worms and worm wheels, which are made from mild steel, case hardened where necessary.

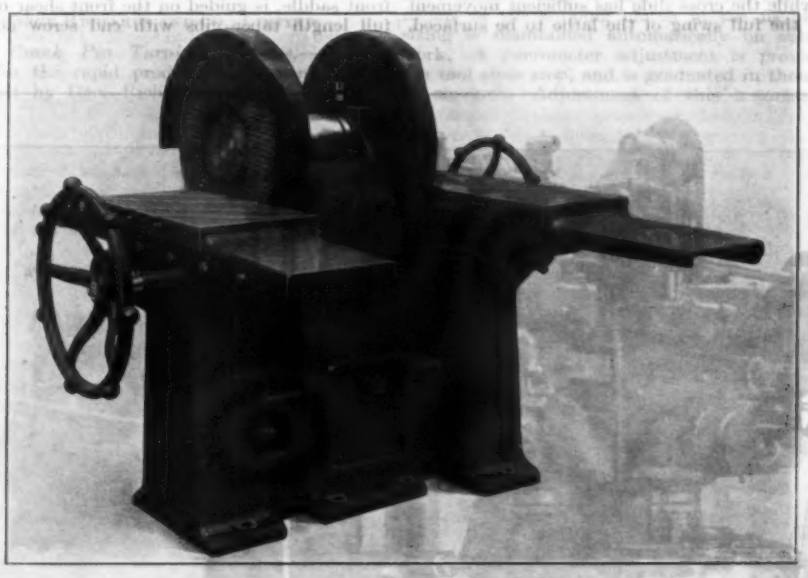


FIG. 24—DISC GRINDING MACHINE—JOHN HOLROYD

Disc Grinding Machine.—The disc grinding machine—Fig. 24—is provided with discs having a series of grooves on the surface to prevent the clogging thereof by the metal. These discs are cemented on to steel discs mounted at each end of a spindle which runs in ball and roller bearings protected against dust. The tables are not fixed on the machine frame but are carried on separate supports to avoid vibration. They are moved longitudinally by means of hand wheels cross movement being effected by small hand wheels provided with micrometer discs for fine adjustment. This machine will grind work 7¼in. high by 15¾in. long. The following are the average speeds of the abrasive wheel recommended:—For hard steel and all brittle materials about 80ft. per second; for wrought iron, soft steel, and all materials that would produce a genuine cutting, about 125ft. per second; for soft material, such as soft bronze, brass and aluminium, about 160ft. per second; for polishing work with very fine discs, about 160ft. per second.

Worm Grinding Machine.—In the 12in. universal hob sharpening and worm grinding machine—Fig. 25—the emery wheel headstock is fitted to a swivelling base, upon which it has vertical adjustment. It is also arranged to swivel vertically on its own base, and is capable of being swivelled horizontally through a complete circle, scales being provided for these adjustments so that the wheel may be set quickly and accurately to any angle required. The emery wheel spindle is of steel, running in ball bearings and is provided with a double ball thrust. The work is held either on a mandrel between the centres, and driven by forked driver and carrier, or in a chuck. The drive is obtained from two independent countershafts, one for driving the emery wheel and one for operating the work. The belt driving the emery wheel passes over guide pulleys which are adjustable to give the belt the correct tension. These pulleys are arranged with side play to prevent the belt riding off the pulley flanges. The work is reciprocated past the emery wheel, and at the same time is revolved at the speed required to suit the lead of the worm or hob, the correct speed being obtained by means of change wheels. Power for the feeds is transmitted by open and cross belts. The automatic reversing and quick-return motions are operated by levers and stops from the reciprocating table. The length of traverse can be varied by suitable stops. The dividing motion is arranged to divide automatically at either end of the work, sufficient over-run being given to the traverse to allow the dividing to take place. A hand dividing motion is also provided. The correct division for the number of starts or gashes in the work is obtained by change wheels and mechanism driven from dividing pulleys at the back of the machine. When sharpening hobs the whole face of the cutting edge is worked on at once, the wheel being shaped to suit the hob form. The feed either for worm grinding or hob sharpening is put on by revolving the work slightly by means of a weight and ratchet pawls on the driver plate, the amount of feed being varied through the agency of a small thumb screw on the driving head. Hand adjustments are provided for the table traverse and also for the vertical and cross feed of the head. The machine will grind worms of a maximum diameter of 12in. and 18in. long. It will admit work 5ft. long between the centres. The speed of the emery wheel is 5500ft. per minute.

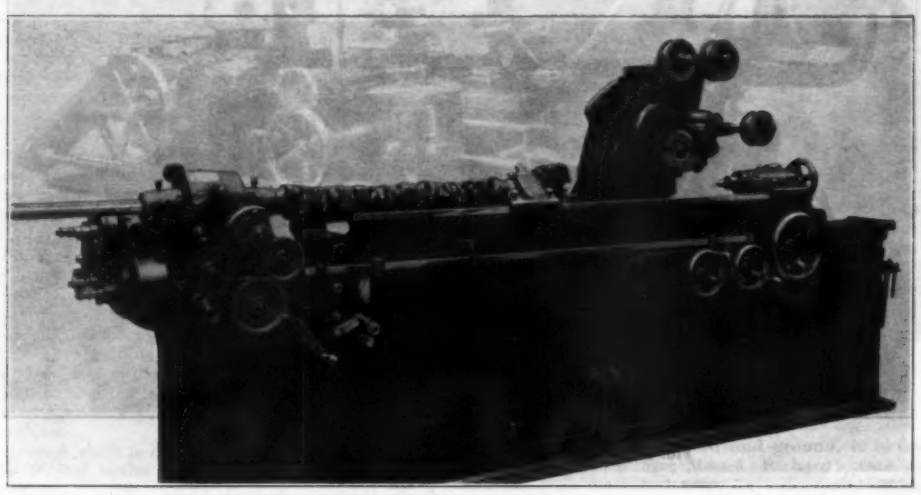


FIG. 25—UNIVERSAL WORM GRINDING AND HOB SHARPENING MACHINE—JOHN HOLROYD

Worm-wheel Hobbing Machine.—The worm-wheel hobbing machine—Fig. 26—is designed to cut wheels up to 4ft. diameter from the solid, either by means of a sliding hob or a fly cutter. The bed of the machine is arranged to carry the cutter head, the work table and the driving arrangement. The cutter headstock is rigidly bolted to the bed. The feed and differential gearing is enclosed in such a way as to permit the parts to be easily taken out for inspection. The work table is revolved by means of worm gearing placed under the tray and running continually in oil. The worm has a special arrangement to enable it to be kept fully in mesh, so as to avoid backlash without the use of split worms or worm wheels. The work mandrel, it will be observed, is securely tied to the cutter head by means of an adjustable brace, which can be swung out of the way when changing the work. The cutter driving spindle runs in capped gun-metal bearings provided with adjustment for wear in all directions. This spindle is bored to a morse taper and is cross slotted for driving the cutter mandrel, a draw bolt being provided for ejecting or holding the mandrel. When using a fly cutter for cutting worm wheels with multiple starts a special locking device is employed. One main bearing carrying the driving wheel and worm is bolted to the side of the cutter head. The cutter slide carries the second main bearing as well as the end bearing for the cutter mandrel. Both these bearings are adjustable on the slide and are bolted in T slots. The end bearing is provided with split bushes which may be easily changed to suit different diameters, and is arranged to compensate for all wear. The slide can be traversed along the bed by hand or by power feed in either direction at various speeds. The slide is also arranged so that the cutter can be fed into the blank slowly until the bulk of the stock has been removed, when the feed can be instantly increased four times as fast for finishing purposes. There is a quick power traverse in both directions in conjunction with the differential, thus enabling a second cut to be taken without disconnecting the settings in any way. The work table slide is gibbed to the bed on narrow guides, and can be securely locked when set, the setting being effected by micrometer hand adjustment. The work table has T slots for clamping the blank, and is supported on a large annular ring. It revolves on a long tapered spindle fitted in an adjustable bushing. The maximum diameter of wheel which can be cut is 4ft., the maximum pitch which can be hobbed in cast iron 2½in., and the

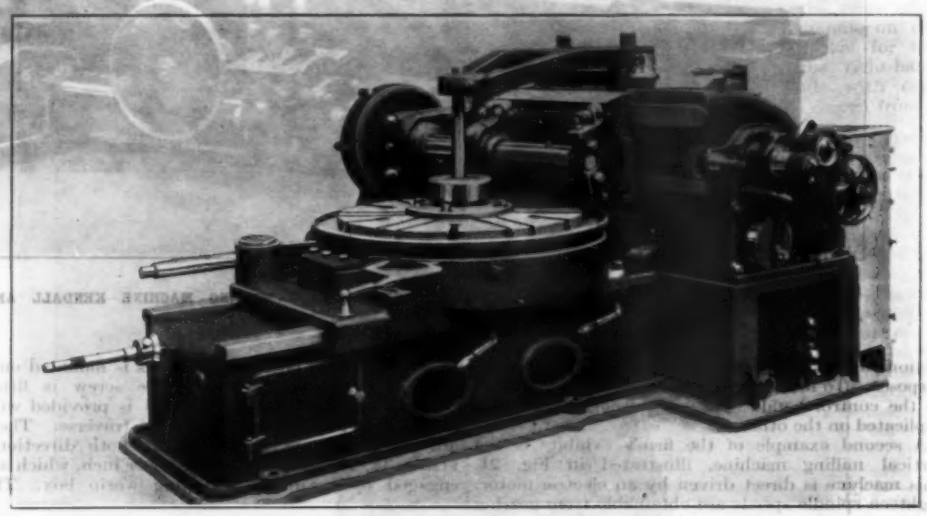


FIG. 26—4 FEET WORM WHEEL HOBBING MACHINE—JOHN HOLROYD

maximum pitch in cast iron with a single cutter 3½in. The machine will admit a hob of 10in. diameter, and the spindle speeds can be varied between 18 and 75 revolutions per minute. The cross feeds of the hob per revolution of the table can be varied from 1/100in. to ⅛in.

Revolving Oil Stone.—The revolving oil stone and general grinder—illustrated in Fig. 27—has been designed for sharpening wood-working tools, and is especially suitable for use in pattern shops. In addition to the revolving oil stones the machine

FIG. 27—REVOLVING OILSTONE AND GRINDER

is provided with an ordinary emery wheel, grinding cone and leather strop. All these details are carried on a pillar base, which can be bolted to the floor. The various grinding wheels are all driven by belt from a countershaft through a pulley on the spindle, and thence through gearing on to the oil stone spindle. The two oil stones are of different grains, one coarse for fast grinding and the other fine for imparting a smooth keen edge to the tools. The oil stones run in an oil bath, covers being fitted to prevent the oil being thrown forward. They are 8in. diameter by 2in. face, the grinding cone measures 3in. diameter by 5in. long, the leather wheel is 5in. diameter by 2in. face, and the emery wheel 8in. diameter by ½in. face. The speed of the driving spindle is 1400 revolutions per minute, and that of the oil stones 200 revolutions per minute.

SELSON ENGINEERING COMPANY, LIMITED.

Maag Gear Cutting and Grinding Machines.—In our issue of March 18th, 1921, we published descriptions of the gear cutting and grinding machines developed by Mr. Max Maag, of Zurich. These machines were evolved in the first instance to cut and grind the wheels of a special type of involute gear wheel system, upon the perfection of which Mr. Maag had spent many years, and for which he claimed many important advantages. In a succeeding issue—April 15th—we endeavoured with the limited amount of information which had been placed at our disposal to give some account of what the Maag gear wheel system was and the principles underlying it. We are not in a position to add anything to the information given in the second of these articles, nor is it necessary to do so, for the Maag machines shown at Olympia on the stand of the Selson Engineering Company, Limited, are being exhibited quite apart from their application to any particular system. They are not, as it appears has generally been thought, suitable only for the manufacture of Maag type gearing, but are, and from the start have been, equally adapted to the production of ordinary spur, spiral or helical gearing with involute teeth according to the standard pattern. The cutting and grinding machines illustrated in Figs. 28 and 29 respectively do not differ from those described in our pages in 1921, but some additional information concerning their construction and operation may be given, for it has been found by experience that certain features in the designs are worthy of special attention, although at an earlier date they were regarded as of secondary importance.

The gear generating machine is of the vertical type and is designed to use the straight-sided rack type of cutter. The gear blank is supported on a horizontal table, the required rolling motion being supplied by only one driving pinion through two sets of change wheels to the lead screws, worm and worm wheel. By this arrangement the motions of the two components for the generating movement are easily kept in correct relation to each other and an accurate involute profile is produced. In addition there is a quick-threaded screw, driven frictionally from a small gear wheel mounted on the lead screw, which moves the work table during the generating motion. The lead screw thread acts merely as a positioning member and has therefore its liability to wear reduced. The effect of these two screws is also automatically to take up backlash between the table nut and the lead screw.

The cutters are carried in a vertical slide balanced by a counterweight, and are securely held in position by two wedges A and B—Fig. 30—one provided with a right and the other with a left-handed screw. The cutter box mouth is inclined to the horizontal to give the cutters a slight top rake which, in addition to securing a better cutting edge, is of advantage when heavy cuts are taken, for the cutter is pushed back against the stops C supporting it at the back of the cutter box, the whole arrangement thus being more rigid than it would be if the cutters were quite parallel. Sufficient depth is provided in the cutter box to admit of a spring steel backing plate being inserted immediately above the cutter which assists in taking the thrust of the cut, particularly when the cutter has been frequently re-ground and the teeth have become thin.

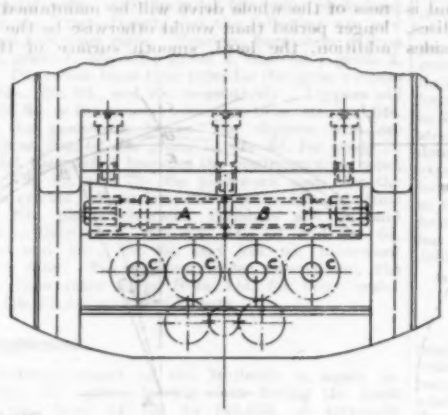


FIG. 30

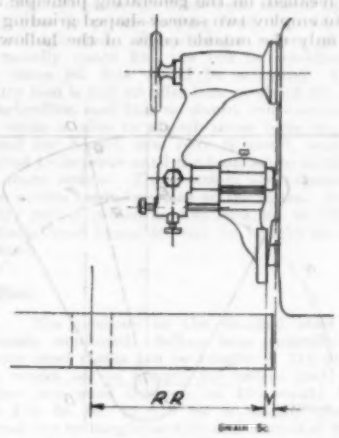


FIG. 31

In any machine required to produce highly accurate gear wheels it is of vital importance that the cutter should be set absolutely true. This important point is provided for in the Maag machine by means of a special instrument—see Fig. 31—which screws on to a scraped face on the cutter ram and has an arm which swings across the teeth of the cutter. The stops C—Fig. 30—behind the cutter, which are controlled by gearing from the front of the ram, enable exact settings to be made before the cutter wedges are finally tightened up. This setting instrument serves a second purpose, for a vernier fitted to the swinging arm enables the exact distance from the scraped face on the cutter ram to the tip of the cutter teeth to be ascertained. By adding the reading thus obtained to the root radius of the gear wheel to be cut the exact tooth depth may be set on a scale mounted on the base of the machine, thus avoiding errors in tooth thickness which are always likely to arise when settings are made from the outside diameter of the gear blank. In Fig. 31 V is the distance from the small scraped surface on the slide to the tip of the cutter, which distance is ascertained when the cutter is being set exactly parallel. R R is root radius of the gear wheel to be cut.

Gear blanks may be rolled into the cutter from either end, but as the cutter in almost every case has fewer teeth than the gear wheel to be cut, it is necessary

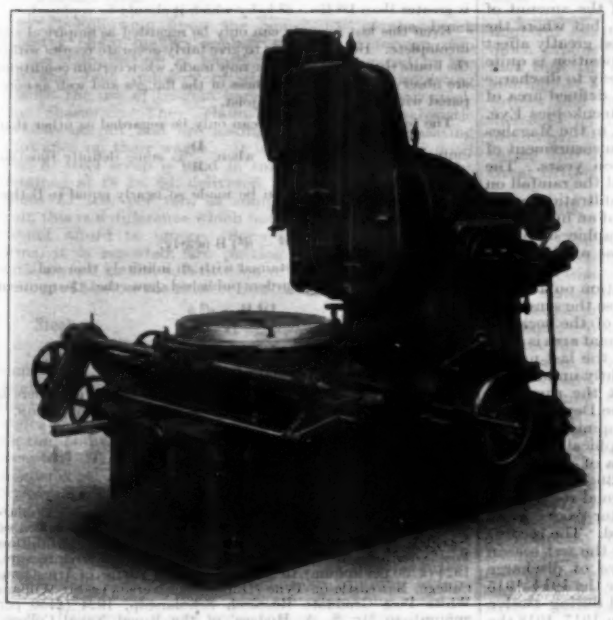


FIG. 28—MAAG GEAR CUTTING MACHINE—SELSON

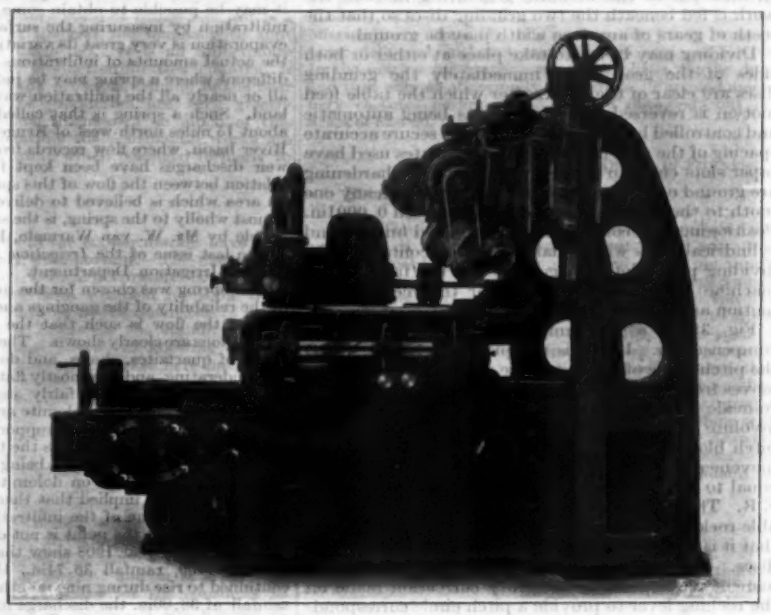
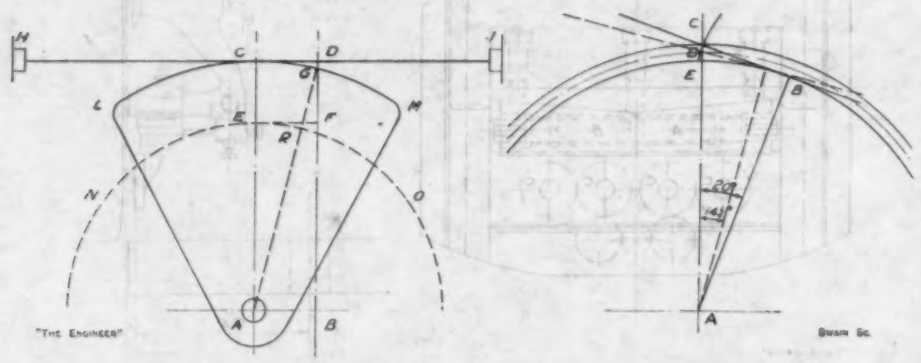


FIG. 29—MAAG GEAR GRINDING MACHINE—SELSON

at regular intervals to return the work to its original position relatively to the cutter. The machine can be set to cut one, two or three pitches per reverse and can be readily controlled to work over any particular portion of the cutter, so that when the first teeth of the cutter become dull the work is simply allowed to roll further into the cutter before the cam drum controlling the reverse motion is put into operation. All the teeth of the cutter are therefore used before re-grinding becomes necessary, thus adding to the life of the cutter and reducing the cost of its upkeep. During the reverse motion the cutter ram is stopped at the top of its stroke clear of the work, the whole operation of stopping the ram bringing the work quickly back to its original position in relation to the cutter and re-starting the ram, being automatically controlled by a cam drum at the back of the machine.

The gear grinding machine—Fig. 29—operates, it will be recalled, on the generating principle and is designed to employ two saucer-shaped grinding discs, of which only the outside edges of the hollow sides



FIGS. 32 AND 33—DIAGRAMS ILLUSTRATING THE COMPENSATION METHOD

are used for grinding. The planes of the cutting edges of these discs when set at an angle to each other represent the sides of a tooth of a rack cutter. The position of each cutting edge is automatically maintained to within 0.00004in. by a diamond-pointed feeler operating a solenoid and compensating screw. Each grinding disc is driven by its own motor and is mounted on a separate table on a common slide, so that the two cutting edges may be set to represent the tooth of a cutter of any pitch. The gear to be ground is mounted on a taper mandril carried on a horizontal slide which is given a reciprocating motion from a crank disc at the side of the machine. Directly in line with the work mandrel and coupled to it through a dividing plate is a sleeve carrying a pitch-block, from which steel bands are fitted to a support. This support is carried on a slide and by altering the setting of a rocking lever true involutes corresponding to any base circle within the capacity of the machine may be ground, using a total of nine pitch-blocks only. In addition to the involute generating motion, the work is fed beneath the two grinding discs so that the teeth of gears of any face width may be ground.

Dividing may be set to take place at either or both sides of the gear wheel immediately the grinding discs are clear of the work, after which the table feed motion is reversed, both operations being automatic and controlled by adjustable stops. To secure accurate spacing of the gear teeth the dividing plates used have taper slots cut into a steel rim which after hardening are ground on the sides so that the error from any one tooth to the adjacent tooth does not exceed 0.0001in. Positioning is accomplished by hardened and ground cylindrical bolts which make only line contact in the dividing plate slots. A gear-box at the front of the machine provides four speeds for the reciprocating motion and four speeds for the feed.

Fig. 32 is a diagram showing the method of compensation. L C M is the pitch block and N E O the pitch circle of the gear to be ground. As the table moves from A to B the point G on the pitch block will coincide with the point D. In order to generate an involute corresponding to the pitch circle N E O the pitch block band supports H and J must be given a movement in the opposite direction to that of the table equal to the difference in length of the arcs C G and E R. This movement is accomplished by the adjustable rocking lever already referred to. It will be seen that it is unnecessary to alter the angle of the grinding discs. These discs can be set to any suitable permanent angle and the necessary correction made on the rocking lever to provide a pitch circle corresponding to the angle of the grinding discs. This procedure gives exactly the same involute as would be secured if the real pitch circle were used and the discs set to the actual pressure angle of the gear wheel. Thus let A C—Fig. 33—be the radius of the pitch circle of the gear wheel. Then if the teeth are to have a 20 deg. pressure angle the radius of the base circle from which the tooth profile is generated will be A B. The involute obtained from this base circle will be precisely the same whether ground at the radius A C with the discs at 20 deg. or ground at the radius A D with the discs at 14½ deg. angle. The pitch at 14½ deg. will be somewhat smaller than at 20 deg., but the Maag machine with its variable pitch grinding discs enables the necessary correction to be readily made.

In the case of gear wheels for motor cars, machine tools and high-speed purposes the teeth of both the pinion and the wheel are usually hardened and ground, but there are, in addition, many cases in which a pinion having case-hardened and ground teeth is designed to mesh with a forged steel, cast steel or cast iron wheel having unhardened and unground teeth. Such a combination is particularly effective if large gear ratios are required or if, in general, there is a tendency for the pinion teeth to wear and lose their correct shape. Directly the involute shape of the pinion profile is destroyed meshing conditions can no longer be correct and wear will increase progressively on both the pinion and wheel teeth. By hardening and grinding the pinion teeth the rate of wear is considerably decreased and the efficiency and smoothness of the whole drive will be maintained for a far longer period than would otherwise be the case. In addition, the hard, smooth surface of the pinion teeth acts as a former or burnisher to the wheel teeth, giving the wheel teeth profiles a polished and smooth surface after the gearing has been in service for some little time.

In connection with the machine tools made by C. Redman and Sons, Limited, Halifax, which are illustrated and described in the special Supplement published with this issue, we are informed that at the last moment Messrs. Redman decided not to exhibit their machines.

Rainfall and Infiltration.

THE relation between rainfall and infiltration is a matter of such great importance to hydraulic engineers that any reliable figures which establish it within reasonable limits in a particular case are sure to attract attention. In countries in which the evaporation is small and regular it may be possible to obtain some idea of the amount of infiltration by measuring the surface flow, but where the evaporation is very great its variations must greatly affect the actual amounts of infiltrations. The position is quite different where a spring may be judged likely to discharge all or nearly all the infiltration water of a defined area of land. Such a spring is that called the Steenkopjes Eye, about 15 miles north-west of Krugersdorp, in the Magalies River basin, where flow records from the measurement of weir discharges have been kept for fifteen years. The relation between the flow of this spring and the rainfall on an area which is believed to deliver its infiltration water almost wholly to the spring, is the subject of an interesting article by Mr. W. van Warmelo, hydrographic surveyor, in the last issue of the *Irrigation Magazine* of the South African Irrigation Department.

This spring was chosen for the investigation on account of the reliability of the gaugings and because the sensitiveness of the flow is such that the waves of the seasonal infiltrations are clearly shown. The catchment area is composed of quartzites, shales, and dolomite, the last-named preponderating, and it is mostly flat or slightly undulating. The southern portion is fairly steep, but the run-off is all discharged on to the dolomite area. The Department's geologist, Dr. A. L. du Toit, supports the opinion that the infiltration area is the same as the topographical area, and he regards the catchment as being an area of 101 square miles, of which 65 are on dolomite and 36 on quartzite and shales. It is implied that there are good reasons for believing that none of the infiltration water passes away underground, but the point is not discussed. The records taken since the year 1908 show that after the wet season of 1908–1909, rainfall 36.74in., the curve of discharge continued to rise during nine months. After the 1914–1915 rainfall of 38.00in. the discharge increased during twelve months, and after the rainfall of 42.69in. in 1917–1918 the discharge increased during twenty-one months.

An outstanding feature is the value of a single season of heavy rainfall. The first heavy rainfall, 1908–1909, did not give nearly such good results as that of 1917–1918, and Mr. van Warmelo explains this as being due to the fact that the season's rainfall was very small until the month of January, which gave over half the total of the twelve months. The surface run-off was large on account of this concentrated rainfall and much water was lost. In the two following years rainfalls of 26.2in. and 27.8in. yielded 2.25in. and 2.08in. to the spring, whereas in the two years following the year with 42.7in. we find that 23.8in. yielded 2.59in., and 18in. yielded 1.85in., percentages of about 11 and 10, to be compared with 8½ and 7½ in the earlier case. The effects of the rainfall of 38in. are much feebler and were doubtless effected by the low rainfall, 18.3in., of the previous twelve months. For the yield of the 38in. was 5.47in., or 14.38 per cent., and the following year the rainfall was only 20.7in., the yield dropping to 1.16in., or 5.6 per cent. It is especially noteworthy, however, that although in the year immediately following the year of heavy rainfall 20.7in. produced so little as 1.16in., or 5.6 per cent., in the next year, 1916–1917, 22.8in. yielded 2.12in., or 9.3 per cent. No explanation of this offers itself, and none is suggested in the article.

Calculations relating to the 36 square miles of quartzite, to which a run-off of 6 per cent. is assigned, lead the author to the conclusion that the average infiltration on the whole of the catchment is 9.56 per cent., that on the dolomite area 11.51 per cent., and the evaporation on the catchment 85 per cent., there being no run-off from the dolomite area.

Letters to the Editor.

THE STRENGTH OF HOLLOW TUBES.

SIR,—In the textbooks two formulæ will be found giving the strength of hollow tubes. The first is simply

$$R^3 - r^3$$

and the second

$$\frac{R^4 - r^4}{R}$$

This second formula can be written

$$R^3 - r^3 \times r^3 \frac{R - r}{R}$$

showing that it gives a greater strength than the first one.

It is interesting to note the difference in the strengths that these two formulæ give.

R.	r.	$R^3 - r^3$.	$\frac{R^4 - r^4}{R}$.	$\frac{R^4 - r^4}{R} \div R^3 - r^3$.
1	0	1	1	1
2	1	7	7.5	1.0714
3	2	19	21.6	1.1368
4	3	37	43.75	1.1824
5	4	91	73.8	1.2098
6	5	91	111.83	1.2281
7	6	127	157.856	1.2430
8	7	169	211.875	1.2537
9	8	217	279.9	1.2626
10	9	271	343.9	1.2694
		1000	1247.114	

If, therefore, the nine tubes and the central solid rod are inserted in each other, their joint strength is 1247, against 1000 for a solid rod of the same external diameter.

But this is impossible and therefore the formula $\frac{R^4 - r^4}{R}$ should be discarded and only $R^3 - r^3$ used. As regards this last formula, I believe it has been proved by experiments in America to be accurate within certain limits.

What applies to circular hollow tubes equally applies to square ones.

The rolled metal joist is simply a hollow square with the two outside webs passed to the centre to form a single web. And the same formula for vertical strength applies to both square and girder. And as with the hollow round tube, so with the hollow square or girder. The formula $\frac{D^3 B - d^3 b}{D}$ is impossible, since it is greater than $D^2 B - d^2 b$, by which it should be replaced.

Even this last formula can only be regarded as empirical and incomplete. But it appears to give fairly accurate results within the limits that rolled joists are now made, when certain conditions are observed as to the thickness of the flanges and web as compared with the depth of the joist.

The formula $D^3 B - d^3 b$ can only be regarded as other than empirical when $\frac{D}{B} = \frac{d}{b}$ or when $\frac{D}{B}$ is some definite function of $\frac{d}{b}$. For otherwise b can be made so nearly equal to B that the formula becomes

$$(D^3 - d^3) B \text{ nearly,}$$

and a strong girder is obtained with an infinitely thin web.

A reference to lists of girders published shows that the quotient

$$\frac{D^3 B - d^3 b}{D}$$
$$\frac{}{D^3 B - d^3 b}$$

is in most cases nearly equal to 1.3.

Hence it would appear that the factor of safety in girders is often only ¾ of what it is supposed to be. W. MOON.

September 5th.

INSTITUTION OF NAVAL ARCHITECTS.—The following scholarships have been awarded by the Council of the Institution of Naval Architects:—Royal Commissioners for the 1851 Exhibition Post Graduate Research Scholarship in Naval Architecture, 1924 (£250 per annum), to Mr. J. Lockwood Taylor, of Armstrong College, Newcastle-on-Tyne (Durham University); Sir William White Post Graduate Research Scholarship, 1924 (£150 per annum), to Mr. S. A. Hodges, of the Royal Naval College, Greenwich; Institution of Naval Architects Scholarship, 1924 (£130 per annum), to Mr. Leslie Digby, of H.M. Dockyard, Devonport; Earl of Durham Prize, to Mr. F. S. Sutherby, of H.M. Dockyard, Portsmouth.

TENDERS OPEN.—The Department of Overseas Trade reports that the Department of Public Works, Sydney, is inviting tenders for the manufacture, supply and delivery of metal work for steel superstructure of six truss and three approach spans for a bridge over George's River at Tom Ugly's Point, New South Wales. Tenders close at the Department of Public Works, Sydney, on November 3rd, 1924. The Department also announces that the Public Works Tenders Board, Wellington, is inviting tenders, to be presented by October 28th next, for the supply of plate girder spans, Wairoa River Bridge, Rangitaiki and Awakeri Section Bridges. British firms desiring further particulars of these tenders should apply to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Quiet Market.

AT the weekly meeting in Birmingham to-day—Thursday—of the Midland iron and steel industry, there was little evidence of any marked recovery in trade conditions, although the slight movement previously noted was maintained, and rather more activity was reported at the engineering foundries in the Birmingham area. There was a fairly large attendance on 'Change, but very little new business was done. Industrialists' attention was focused on the prospects of the autumn, both with regard to production costs and selling opportunities. The inquiries do not open out prospects at present of improved buying, business continuing to be for immediate delivery. Forward contracting is still absent. Iron founders appear to be moderately engaged. Iron and steel masters who anticipated that some business might be deflected into this district as the result of the closing down of certain big works in other areas have so far been disappointed

Bar Iron.

There is no alteration in the position of the Staffordshire finished iron trade, and though best bars at £15 per ton are called for with fair regularity, merchant bars are extremely slow of sale. The railway companies are the best customers for high grade material. Crown bars selling at £13 have little chance in competition with steel at £2 10s. to £3 below this price. Makers of nut and bolt bars—quoted at £12—are not likely to get much support from the industry using them, so long as the district is overloaded with Belgian bars and shippers offer supplies at £3 10s. or more below the native price. Stocks have accumulated owing to diminished consumption, and are an obstacle to further business. If there is a silver lining to the clouds which at present obscure the Staffordshire trade, it is to be found in the slightly improved activity shown in the restoration and replacement of engineering equipment, in preparation for the greater activity which, it is believed, must ensue later in the year, and in the somewhat better tone in chain and cable iron.

Pig Iron.

Pig iron prices are steady, but there is no increase in the call for either forge or foundry sorts. The slight improvement in demand last month has not been augmented, and in some quarters it is considered that it was due almost entirely to speculative buying. Small orders for urgent needs continue to be received, but no one is buying forward. Northamptonshire furnaces want £3 17s. and upwards for forge iron and £4 2s. 6d. for foundry sorts. Derbyshire makers ask about £4 for forge and £4 5s. to £4 6s. 6d. for foundry; while North Staffordshire makes are quoted forge £4 2s. and foundry £4 10s. Sellers of blast-furnace coke have been endeavouring to get higher prices but without success. Coke prices will shortly come up for review, and smelters are urging the necessity for better terms. Since the present basis was fixed the position of the cokeries has weakened. Durham coke has had a pronounced fall, and can now be bought at rates which make it worth while to import it into South Staffordshire.

Foreign Iron.

Following upon the complaints of the Black Country chain makers against the use of foreign iron in the manufacture of chain, workmen engaged in the nut and bolt industry of this district are protesting against the use of Belgian bars on account of their steel-like character. They claim that this characteristic reduces output and are asking for some compensating allowance on their wages. It is well known that a good deal of steel scrap is used in this iron, but as it can be obtained at £8 2s. 6d. delivered, representing a saving of about £3 10s. per ton, as compared with Staffordshire iron, this is a difference which nut and bolt manufacturers cannot afford to ignore. Some nut and bolt making firms, it is reported, are putting in special machinery with a view to the substitution of mild steel, obtainable at about £2 below the price of Staffordshire iron.

Steel.

Price cutting continues in practically all departments of the steel trade. Demands of consumers are small, and competition for the few orders which come on to the market is extremely keen. The figure of £9 10s. for angles and joists is being shaded to the extent of 2s. 6d. per ton, and in exceptional cases £9 5s. is said to have been accepted. The associated houses are now following the independent firms. Price agreements have obviously broken down. Small bars are on offer at £9 5s. Mild steel billets are obtainable at £7 10s., although it is commonly stated that this price does not cover the cost of production. Belgian and German billets continue to be offered at £6 10s., and competition from these quarters is becoming keener. The Germans are quoting exceptionally low prices. Basic bars are offered by them at £7 5s. delivered. Local steel makers are pressing for specifications and have great difficulty in keeping their mills employed even on short time.

Galvanised Sheets.

Producers of galvanised sheets are showing increased caution with regard to forward contracting. Movements in the trade inspire some confidence, and prices of 24-gauge corrugateds are firm at £18 5s. f.o.b. The advance of 10s. in the price of 30-gauge sheets has not appreciably affected business.

Wire.

Several price reductions have taken place in the wire department. Galvanised strand wire, No. 4-gauge, has fallen 30s. per ton, viz., from £29 10s. to £28. Bright staple wire has been reduced 5s. per ton, making the basis £17 10s. for No. 8 gauge. Wire mills are fairly active, but foreign competition remains very keen.

Rolling Stock Industry.

Midland rolling stock concerns are fairly well employed, and orders lately received will keep them busy for a month or two. The home demands are providing a good proportion of the work, export business being rather slow, and orders being difficult to secure in the face of the keen competition of Belgium and Germany. Productive resources are not, of course, fully utilised, but the industry is more fully occupied than most of the engineering trade's affiliations.

Wages in Metal Wares Trade.

Wages of adult male workers in the stamped or pressed metal wares trade have, as from this week, been raised by the Trade Board, and the following are now the general minimum rates. Braziers, burnishers or drop stampers, grade 1, 55s. 6d.; grade 2, 62s. 6d.; grade 3, 67s. 6d. Piecework basis time rates for the same workers become 64s., 72s. 9d., and 79s. respectively. Dippers will receive 55s. 6d. as the general minimum time rate, and 64s. becomes the piecework basis. For dippers who are also bronzers, 55s. 6d. for grade 1; 62s. 6d. for grade 2; and 67s. 6d. for grade 3 becomes the minimum time rate; and 64s., 72s. 9d. and 79s. the piecework basis for the respective grades. Annealers will receive 55s. 6d. time rate and 64s. piecework rate. Polishers will be paid according to their grade, 55s. 6d., 64s. 6d. and 69s. 6d. time rates and 64s., 75s. 3d. and 81s. 6d. piecework basis time rates. For workers under twenty-one, the minimum time rates range from 14s. for boys under fifteen to 39s. 3d. for youths of twenty.

Unemployment.

Unemployment in the Midlands is again on the increase, the figures having risen during the week by 945, viz., from 147,731 to 148,676. A fortnight ago the number of workless was 148,216, so that last week's decrease has been more than swallowed by the number now added to the Ministry of Labour's register. In the Birmingham area 894 persons have been added to the list of workless, and at Coventry 543. Other Midland towns which show an increase for the week are Cradley Heath, Dudley, Smethwick, Worcester and Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

ALL the markets here are quiet and in a waiting mood, and business is consequently much restricted. The iron and steel sections are much more depressed than the non-ferrous sections, but variations in prices for iron and steel are not so frequent as in metals, probably because most kinds of iron and steel are now sold without any profit for the producer. It is largely a question in the iron and steel trades as to whether it is worth while to take orders without profit or even at a small loss rather than to stand idle at heavy overhead charges. How long this very unsatisfactory state of things can last is a doubtful matter, but in the end the tendency to shut down producing plant must tell. It is an unfortunate fact that the power of production in this country is enormously in excess of any probable demand in the near future, and the costs of production are very greatly increased by the resulting idleness of so much of this productive power. Meantime the continental works are eating into the foreign trade which belonged formerly to Great Britain.

Metals.

The movements in the copper market have been small and comparatively unimportant. The exact position in America is not known accurately because the usual statistics have now been withheld for some time, and people are merely guessing at the quantities of metal available. Whether it is better for the stability of the market for people to guess instead of knowing remains to be seen. Prices in the copper market here have been fairly steady for a week or so, and the movements have been so small that it has not been worth while to make any change in the official prices for sheets and manufactured copper and brass. These prices continue to show a very large margin in favour of the manufacturer, at any rate, so far as the quotations to the home consumer are concerned. There has perhaps been a slightly better disposition on the part of copper consumers here to buy for stock, and some merchants report a fair amount of business. The market movements during the last few months certainly suggest that there is not very much risk of any serious fall in copper; and in such circumstances it is probably good policy for the consumer to have a moderate quantity in stock. If the wisdom of this policy becomes universally accepted it will make a big difference to the statistical position, because "visible" stocks will then become "invisible" stocks. Perhaps the American trade will then be anxious to publish statistics again. The market for tin has fluctuated a good deal, but, on the whole, it seems to be stronger. No doubt the progress made in liquidation of what is known as the F.M.S. pool has a strengthening effect, but what is wanted to sustain and increase present prices is a greater certainty that the American consumption will be large during the remainder of the year. Europe will probably be able to take more tin, especially if the loans to Germany and Russia go through. Already an increase in buying has been reported from South Wales. Sellers here seem very confident that higher prices are coming, but, of course, the opinion of sellers has always to be taken with caution. Lead and spelter have both been fairly steady markets, and there is no sign yet of any weakening in the former. Supplies of lead have been good, if not actually large, but the demand keeps up and seems quite capable of absorbing all that comes in.

Pig Iron.

The market here for foundry iron is very quiet and steady, and the general attitude, both of buyers and sellers is that of "waiting for something to turn up." Whether anything definite will turn up this autumn is perhaps doubtful, but it is difficult to form any decided view as to the future. A great deal must depend upon whether the Cleveland ironmasters can recover their export trade; for, if not, the price of Cleveland No. 3 is bound to recede still further, and this will bring down the level of our local prices. While there is a possibility of this development, the large consumers here will probably postpone the making of forward contracts for foundry iron, although some No. 3 has been bought up to the end of the year at prices varying from 92s. 6d. to 93s. 6d. per ton delivered. The stronger sellers of Derbyshire iron usually quote 94s. per ton in Manchester, but in most cases 6d. less would be accepted. Lincolnshire foundry iron is still on offer here at about the same prices as Derbyshire, and this no doubt will continue until the steel trade is able to absorb more basic pig iron. The demand for Scotch iron here is small, and cannot be expected to improve until the Lancashire textile engineers have more orders. These orders are expected as soon as the cotton trade becomes active again. Scotch No. 3 foundry iron is quoted here at 107s. 6d. to 108s. per ton; but East Coast hematite may be bought at about 104s. delivered.

Steel.

The position in the finished steel market is practically unaltered. Sellers here generally deny that ordinary steel plates can be bought at £10 per ton; but many works are so hungry for orders that one doubts whether any good business at £10 would be refused. From £10 2s. 6d. to £10 5s. is usually quoted. Flat bar steel can be bought at £10, and rounds at from £10 5s. per ton. For joists and angles the nominal quotation here is still £9 7s. 6d. with £9 5s. as the bottom price for British material. Foreign steel could be bought here at from £7 to £7 5s. per ton delivered; but when it would be delivered is a doubtful question.

Iron.

The demand for Lancashire iron is still very poor. Apparently the manufacturers cannot sell enough to keep the works going even at half pressure; and until the mills are running full time it seems impossible to get the prices down; while, on the other hand, there is no doubt that the comparatively high prices prevent any expansion in the sales. There is an attempt now to introduce a good quality of Belgian bar iron into Lancashire, but the prejudice against it is very strong.

Scrap.

The scrap trade is in a very depressed state, but this is inevitable so long as orders for new iron and steel are so scarce. Dealers here are very reluctant to increase their holdings until they can see some chance of a better demand. The prices they offer now for heavy steel scrap are variable, some refusing to give more than £2 per ton on trucks. A more usual buying price is, however, 62s. 6d. per ton. The ironworks are not now offering more than 87s. 6d. per ton for heavy wrought scrap delivered, although some dealers hold out for 90s. In the market for foundry scrap very little can be done, and that only at abnormally low prices. For good machinery castings perhaps 85s. may be obtained, but one hears of 82s. 6d. more frequently.

BARROW-IN-FURNESS.

Hematite Still Dull.

The hematite pig iron market still remains dull and there is no sign of improvement. The output at present exceeds the tonnage sold, and much pig iron is going into stock. The fact that the steel departments are to a great extent idle means that much of the iron which went into the converters is being put into stock, and unless the rail and merchant mills start again it will mean at Barrow that there will have to be a curtailment of output. This restriction may effect more than one furnace. Trade generally in mixed Bessemer numbers is on a small scale, for most customers are only taking what they immediately require. The business being done with the Continent is small. A cargo left Barrow for Antwerp last week, but it was not a very big one. American business is small. There is only a moderate demand for special qualities of iron.

Iron Ore.

The iron ore trade remains quiet, and there is always the fear that it will shrink further if there is a restriction of output by the furnaces. There is not much leaving the district. The Furness mines are not very well situated for orders. Foreign ore is being brought in in moderate quantities. One cargo of Spanish ore arrived at Barrow last week from Kirkenes.

Steel.

The steel trade, generally speaking, is in a very bad way. There are no signs of the Barrow rail and merchant mills restarting, and this means that over a thousand men will continue to be out of work. The market is very dull indeed, and for what few orders are available the competition is exceedingly keen. Prices allow no margin of profit whatever. The foundries and the hoop and small section mills are better circumstanced and have sufficient orders to keep them going regularly.

Fuel.

There is only a moderate demand for fuel, and both as regards East Coast coke and steam coal there is room for much improvement. The local coke requirements are likely to fall off.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

EFFORTS to bring about a settlement of the strike in the heavy steel trade has so far proved fruitless, with the result that three of the largest works in the district are still standing idle. This would appear, however, in a way, to be a matter of little consequence from the point of view of the present trade situation, from which it would appear that the contraction of output brought about by the stoppage is not causing any shortage. There has been a further falling off in the volume of orders for billets and similar material, and the present limited production of the furnaces is more than enough to satisfy the demand. No one in the trade remembers a time when orders and specifications were on such a small scale as to-day, and many of those concerned are feeling alarmed with regard to the immediate future. On the railway steel side, the quantity of work on hand is still good, but is much behind the capacity of the local plants. The orders actually placed in this district have not been by any means as extensive as were expected, after the announcement of huge contracts to be given out by the various railway companies. It is, in fact, stated that the orders received from home companies this year have not been equal to those of the corresponding period of last year. Much disappointment is expressed at the small amount of business coming from overseas. South America does not give much cause for complaint, but a large amount of Indian work has gone to the Continent.

The Lighter Branches.

A more cheerful tone continues to characterise the lighter branches of the steel trade, and the better outlook in shipbuilding and engineering is reflected in the tool trades. The individual orders coming to hand are mostly for small quantities, but there is a steady and increasing flow of them, which indicates that in various parts of the country a good deal of work is in progress. The improvement in the crucible steel trade is not yet general, or on a large scale, but some firms are able to report progressive business. A branch of the manufactured steel trade of which it is not possible to report a healthy condition is that which produces shoes and dies for use in crushing ore at the South African gold mines. This was a valuable department until recent years, but the trade has now been largely taken up in South Africa itself, where quantities of good scrap are produced by the railways, and electric furnaces have been installed for its treatment. The cost of freight from this country is so high that English material has great difficulty in competing with that made on the spot, and the consequence is that to a large extent the trade has been lost to Sheffield.

Cutlery and Plate.

There is no further improvement to record in the cutlery trade. The table knife branch is still the most active, and the output is probably greater than that of pre-war years, but the number of firms engaged in the trade has more than doubled, and consequently it is the exception to find anyone who is really busily employed. Electro-platers report a rather better inquiry for good hollow-ware, and a large demand for unplated spoons and forks. The trade in sterling silver ware is very flat, and relates for the most part to presentation articles, spoons and forks.

Tramway Trackwork from America.

Sheffield has again had the mortification of seeing an order for steel goods, required by an English municipality, sent abroad. In this case, Sheffield was not left out in the cold altogether, but it secured only a part of the contract. The goods required were manganese tramway points and crossings for Manchester. The lowest tender came from America, and amounted to £15,478, while the lowest British tender was £16,408. The Manchester Corporation took the lowest tender price for each job, giving £8375 worth of work to America, and £6950 worth to Sheffield, dividing the orders for this city between Hadfields, Limited, Edgar Allen and Co., Limited, and the Titan Trackwork Company, Limited. The decision was not come to without a keen discussion, and an amendment to refer back the recommendation of the Tramways Committee was only defeated by 39 votes to 25. Sheffield manufacturers, asked for their views as to the reasons of America's ability to undercut them, referred pointedly to the heavy burden of taxation which has to be borne in this country. While on tramway matters, it may be mentioned that the Sheffield Corporation Tramways Committee has decided to purchase from the Associated Equipment Company, Limited, Walthamstow, eight new motor omnibuses. The A.E.C. chassis are to be complete with electric lighting equipment, and will be fitted with double deck all-weather bodies—for £1695 each. Six of these omnibuses are required for the Petre-street section, which, as reported a few weeks ago, is to be converted from a tramway into an omnibus route.

A Nottinghamshire Railway Extension.

The London, Midland and Scottish Railway Company has placed a contract with Logan and Hemingway, Limited, of Doncaster, for the construction of a single line of railway and loop at Blidworth. The line will start about half a mile east of Blidworth Station, between Mansfield and Southwell, and will run to New Blidworth colliery, a distance of about a mile from the other line. The work will involve extensive excavations in sandstone, and also the building of a bridge over the main road from Mansfield to Southwell. The contractors estimate that the work will occupy about eleven months.

Colliery News.

Developments are being carried out by Newton, Chambers and Co., Limited, of the Thorncliffe Ironworks and Collieries. For some time past they have been drifting from Fenton Wood, within the Rotherham boundary, to the Parkgate seam of coal, and possibly the underlying Silkstone seam. Large poles have been erected, indicating that the coal, when won, will be conveyed by aerial ropeway to Bradgate and the Grange Colliery, which was closed for coal winding some time ago. There is considerable building activity throughout Thorne and district, consequent upon the colliery developments there. From an older part of the South Yorkshire coalfield comes news of a less cheery character. The Mitchell Main Colliery Company has decided to close its Darfield Main Colliery, on the ground that the company cannot afford to pay the district rates. Mr. Joseph Jones—secretary of the Yorkshire Miners' Association—says the owners claim that they have carried on the working of the Melton Field seam at a loss since 1906, and that during May, June, and July this year they lost, at Mitchell Main and Darfield Main—mostly at Darfield Main—£24,000. At the new Ollerton Colliery, in North Nottinghamshire, the No. 1 shaft has now been sunk to a depth of over 500ft. A good deal of water is being met with. Electric pumps are constantly at work and are said to be removing 800 gallons of water per minute from the shaft bottom. At one time the flow was as much as 1200 gallons a minute.

Sheffield Winter Schemes.

Subject to the necessary Government grants being obtained, Sheffield proposes to proceed with works, for the purpose of providing relief of unemployment during the coming winter, which will involve a total expenditure of £484,934. There are four road-widening schemes, namely:—Bawtry-road, £12,000; Richmond-lane, £36,000; Furnace-lane, £10,000; and Wadsley-lane, £4000. The Electric Supply Department is to lay four important extra high-tension mains at a total cost of £61,459. A further instalment of the sewage disposal scheme is to be carried out at a cost of £112,761; £100,000 is to be spent on the foundations, &c., of the abattoir; £50,000 on roads and sewers on the Manor Estate; and £37,000 on a sewer from Woodhouse to Intake; £30,914 on Hillsborough baths; and £23,000 on Retford-road bridge; in addition to smaller works.

Nottingham's Waterway to Hull.

I have previously referred to the important scheme which is in hand for linking up Nottingham and Hull by making the river Trent navigable for the passage of 120-ton vessels. Great progress has been made, and at the end of this month members of local bodies and trading organisations, along with a representative of the Ministry of Labour, will make an inspection of the completed work. The scheme, which was begun three years ago, involves an expenditure of about £500,000. So far as the construction of the locks is concerned, the work is now practically complete, and the weir at Stoke is finished. Dredging operations have still to be carried out in connection with the locks, and other weirs have to be made at Gunthorpe and Hazelford.

Swiss Electrical Equipment for York.

The tender of Oerlikon, Limited (Switzerland), for the supply of a 6000-kilowatt turbo-alternator and condensing plant, has been accepted by the York Electricity Committee. The amount of the tender was £18,671, while the lowest English quotation was £26,824. It is stated that about £11,000 out of the total of £18,671 will be spent by the Swiss firm in England, and that the only part of the plant manufactured abroad will be the turbo-generator. The cost of this is approximately £8000, and it was in respect of this part of the equipment that the main difference between the English and Swiss tenders lay.

NORTH OF ENGLAND.

(From our own Correspondent.)

Dismal Trade Position.

DOLEFUL accounts are given of almost every branch of industry in the North of England, and the outlook for the winter months is distinctly discouraging. Depression hangs over the coal trade like a gloomy pall. Several collieries in Northumberland and Durham have already been closed down, and others are contemplating a similar step owing to the impossibility of operating without loss. The demand is so small and the market so seriously depressed that even the most productive collieries find it impossible to work at anything like full pressure. The depression in the iron and steel industries is also becoming more and more pronounced, and a very pessimistic view is taken of the prospects. Of the 113 blast-furnaces built on the North-East Coast only 42 are at present in operation as compared with about 70 in normal times. Of the number in operation, 12 are making Cleveland pig iron, 14 are producing hematite, and 16 are manufacturing special kinds of iron. Shipbuilding and engineering establishments are running short of work, and at least one shipyard is likely to be closed down in the course of a week or two.

Cleveland Iron Trade.

In every direction there is dulness and apathy in the Cleveland iron trade. New business is the subject of the keenest competition, and even deliveries under contract are being curtailed. Prices continue to sag, which is a standing temptation to home consumers to hold off the market, yet even at the present depressed figures it is affirmed that Cleveland makers are being undercut by continental producers. Although inquiries from abroad are more numerous, there is very little business, if any, passing on export account. The home demand too, has fallen to a very low ebb. As yet movement to arrange autumn requirements usually experienced at this period of the year has not appeared, and fear is now entertained that the volume of business over the back-end of the year will fall considerably below what has been expected. Some makers are still asking 82s. 6d. for No. 3 G.M.B. Cleveland pig iron, but buyers report that they have no difficulty in purchasing supplies at 6d. below that price. No. 1 is 87s. 6d., No. 4 foundry, 81s. 6d.; and No. 4 forge, 80s. 6d. per ton.

Hematite Pig Iron.

The East Coast hematite pig iron trade displays no life. Present prices are not attractive to buyers abroad, and the home demand is limited, first by the downward curve of prices, and secondly by the slackness at the steel works. The stoppage of more furnaces is said to be by no means a remote contingency. Mixed numbers are quoted at 91s., and No. 1 at 91s. 6d. per ton.

Ironmaking Materials.

There is complete stagnation in the foreign ore trade, and nobody looks for other than the possible sale of an odd cargo until the general prospects of the iron trade are brighter. The price of best Rubio ore at 22s. 6d. per ton c.i.f. Tees is purely a nominal one, and doubtlessly business could be done at a rather lower figure. A rather firmer export market for coke has stiffened the price, and good medium furnace kinds are steady at 26s. per ton delivered at the works, though there is little demand.

Manufactured Iron and Steel.

There is not the slightest indication of returning animation in the manufactured iron and steel trade. The Indian tariff has severely restricted business in Cleveland's best market, and in other directions continental competition is very severe. In the home market there does not appear to be a great deal of foreign steel on offer, but such as there is, is quoted well below home makers' prices, and there is a good market for foreign billets even with British steel firms. Home prices are nominally unchanged, but there is a good deal of undercutting for foreign orders.

The Coal Trade.

There has been no improvement in the general tone of the Northern coal trade, and a pronounced feeling of depression is in evidence. Continental inquiries are reported to be coming forward, but the prices offered are much below merchants' ideas, although these are based on the current low-ruling values. Business is, therefore, at a discount. In no section of the trade is there any firmness, and the most favourable brands have difficulty in maintaining recent prices. Fitters generally endeavour to hold steadily, but have to face short-time working. In other cases it is a question of taking any orders offered at buyers' figures, or lay the pits idle. Fitters, while struggling gallantly to keep things going, see little encouragement ahead at the moment, and the prospects point to present prices only being maintained by a drastic cutting down of production. In the Northumberland area there are a large number of collieries standing idle, and unless the trade position improves the position is likely to become even more serious by the closing down of other pits. Over fifteen hundred miners employed at the Seaton Delaval collieries have received fourteen days' notice, making 2700 of the company's employees now involved. Four pits are to be closed down for an indefinite period. In the Durham coalfield there are 14 pits idle, and nearly 9000 miners are receiving out-of-work allowance from the funds of the Durham Miners' Association. Both districts are having to face keen competition from the Continent, particularly Germany and Belgium, and as a consequence some difficulty is being met in getting contractors to take out their full supplies. The coke market is steady for all makes, and prices are unchanged.

SCOTLAND.

(From our own Correspondent.)

Dull Conditions.

NOTHING has occurred during the past week to brighten the industrial situation, and markets remain in a dull and unsatisfactory condition. The policy of caution is extremely evident in practically all directions and has only been intensified by the latest turn in the attitude towards the German financial question. It is only to be expected that the loan to Germany should be received in industrial circles here with mixed feelings. Some are in favour, while others are asserting that the result of the proposal will be increased competition, evidence of which is already apparent. The position at home could hardly be much worse than during the past few months. Now and then a brighter note has been struck, but nothing of a lasting nature has arrived to stimulate business in general. Occasional spurts have been noticeable in the steel and coal trades, chiefly the latter, but markets have for the most part been dull and uninteresting. The position to-day is no better. Home consumers are not in a position to buy lavishly, while the foreign trade is only a shadow of its former proportions. Minimum outputs are the rule rather than the exception, and while prices show little variation from week to week it is almost certain that substantial reductions could, in many cases, be secured when a favourable order is in prospect.

Pig Iron.

The demand for pig iron is very disappointing. The local steel works take very small supplies, and the

same applies to the ironworks. Hematite is quoted about £4 16s. 3d., but an easier price might be obtained. The output of foundry pig iron is very small at present, but it is, nevertheless, equal to all demands at the current rate. Foundry No. 1 is quoted £4 18s. 9d. and No. 3 £4 13s. 9d. per ton. The export inquiry is meantime practically negligible.

Steel Sheets the Bright Spot.

Generally speaking, the steel makers are feeling the decided lack of specifications, and the mills are working far below capacity. Plates are poorly placed, and sectional materials are not much better off. Light sheets are busy. Recent orders have not been large, and inquiries have fallen off somewhat, but the business already booked will keep the works busy for some time yet. Heavy sheets are slow. Galvanised varieties, however, are in strong demand at present and prices are very firm.

Quietness in Bar Iron.

Business in bar iron moves slowly indeed. The inquiry for smaller sizes experienced a slight spurt, but no improvement of a lasting nature is anticipated. Prices show no change. Re-rolled steel is in a similar position with prices tending somewhat easier.

Coal.

The coal market has not been too steady during the past week. Prompt orders have fallen off to some extent and, apart from Lanarkshire splints, Fifeshire navigations and steams, round fuels have not been particularly busy so far as new business is concerned. Among smalls treble nuts are strong, but all other descriptions, and especially single nuts, are plentiful and weak in tone. Forward transactions are practically nil at present. Aggregate shipments amounted to 285,247 tons, against 280,387 tons in the preceding week and 345,528 tons in the same week last year. In the home market the position is unchanged. The demand for industrial sorts is most disappointing, and household fuels are not particularly busy owing partly to the higher prices coming into force somewhat earlier than usual.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

NOTHING has occurred during the past week to put a brighter complexion upon the coal trade or its future prospects. Both coalowners and exporters have been disappointed that there has not been more tangible evidence of a broadening in the foreign demand, but allied countries, at any rate, are well supplied with coals, and the competitor most to be feared is Germany. The inquiry from European countries continues to be very meagre, and the prices that are offered for the occasional cargo needed are comparatively low, especially considering the risks which have to be faced. While coal prices are about at their lowest consistent with the costs of production, the freight market shows some improvement. It looks very much as if rates of freight for the Mediterranean at least will go rather higher though there is a disposition to believe that values will not rise sharply on account of the limited quantity of business. At any rate, it is possible that rates may advance sufficiently to cause some anxiety to merchants who have taken c.i.f. risks as the margin of profit is cut so very fine nowadays in order to secure orders for which competition is so keen. The position is that recently so much tonnage has been attracted westwards for the improved rates offered homewards for grain, that many owners have sent their steamers out in ballast. For a few weeks this is likely to make an appreciable difference to the supply of tonnage available for the Mediterranean, more particularly the upper ports which are distinctly firmer. Meanwhile collieries, all excepting those producing the superior grades of steam coal, are none too well placed for prompt orders, and the docks are easy in the matter of tonnage. Quite a number of idle berths is reported in the early part of this week at South Wales ports. This inevitably means that merchants will have to concede higher rates of freight for prompt steamers, while at the same time collieries will be compelled to make some concessions to buyers of prompt coals or else temporarily suspend working at the pits. Still although the position in the coal trade gives cause for no little amount of anxiety hopes are yet entertained that later in the month a better inquiry will be experienced. As a rule, when normal conditions prevail most people are on the point of considering the question of contracting for coals for delivery over the following year, but needless to say this year, with the outlook so uncertain, scarcely anyone has given it a thought.

Miners' Wages.

A brief reference was made last week to the fact that there would be no change in the wage rate for this coalfield during the current month, as the minimum under the national agreement will apply. According to a statement issued by Mr. Finlay Gibson, the South Wales Coalowners' secretary, the trading results which are now available of the last three months under the new wages agreement clearly show the effect of the higher wages cost which has been imposed upon the industry. He pointed out in previous statements that the trading profit in May was only 2½d. per ton, and in June there was a loss on the whole output of 1s. 4·9d. per ton. Taking the three months together there was a loss of £198,382, or 3.98d. per ton on the output of 11,946,373 tons produced in that period. During the months of January, February and March for an output of 12,655,000 tons, the amount of wages paid including subsistence and guaranteed wages, was £7,505,000 under the old agreement, whereas in May, June and July under the new agreement, the actual wages were £8,028,000 for an output of 11,946,373 tons, which gives an increase in the wages bill of over half a million pounds, with a decrease in the output of nearly 710,000 tons.

Dry Dock Trouble.

The stoppage of work on the part of the members of the Amalgamated Engineering Union affecting fitters and others continues, and, as a consequence, work in the dry dock and engineering line is very quiet. At the same time the various firms have a certain amount of work in hand. It must be confessed that this work is on a scale greater than was expected would be the case, considering that the suspension of work on the part of such an important body of men has now been in operation for a fortnight or more. Unfortunately there does not appear to be any prospect of an immediate settlement of the dispute, and no steps are apparently being taken by either side to bring the trouble to an end. Of course, it is inevitable that orders should go to other ship-repairing districts, and one instance at least of a fairly substantial order having been lost has come to light. The reason was that in the circumstances existing in South Wales the employers were unable to quote.

Current Business.

The tone of the steam coal market has ruled extremely quiet. The best grades of coal have held their own relatively the best, but as regards the lower grades orders are very scarce and prices are barely maintained. Supplies of the majority of descriptions are plentiful, and the market for small coals is slightly easier as the demand is unequal to the supplies available. Coke is also a shade weaker than a week ago, but there is no alteration in patent fuel. Pitwood is not so steady on account of the scarcity of empty wagons, which are monopolised by the heavy stocks of coal. Anthracite coals are very steady and have a tendency to go firmer as the demand is good. In fact, the only spot in the market which cannot be described as satisfactory is that for rubbly culm, though later this may improve.

Tin-plates.

Owing to increasing costs the Stabilisation (Prices) Committee has advanced the minimum price of tin-plates 6d. to 23s. 6d. basis I.C. f.o.b. Bristol Channel ports, and tin-plate bars have also been put up 3s. 6d. to £8 12s. 6d. f.o.b. less the usual rebate of 4s. 6d. to the tin works.

Pits to Close.

Guest, Keen and Nettlefold, Limited, has given notice to terminate the contracts of the miners employed at the Bedlinog pits. They operate in fourteen days, and about 2000 men are affected. It is reported these pits are to be permanently closed and dismantled, as they are old pits, and heavy losses are incurred working them. The company closed down the two Fochriw pits and the South Tunnel a few months ago, throwing 2500 men out of employment, so that the position in the Dowlais area is very depressing.

A REINFORCED CONCRETE LIFT TOWER.

A SOMEWHAT unusual lift tower, which provides access to a hotel standing near the edge of a high cliff near Ventimiglia, was described in a recent issue of *Il Concreto Armado*. This tower, designed by Ing. Cav. Locchi, is 271ft. high with a cage travel of 233ft. Up to a height of 174ft., the sheer part of the cliff, it is anchored to the face of the cliff by continuations of five horizontal braces, the lowest and highest being double, corresponding to small, specially stiffened bays in the sides of the tower. At the height of 238ft. the tower is braced by the gangway which connects it to the hotel. The tower is of square section, with four corner columns arranged at 9ft. centres, well braced together. Each side has three pairs of cross braces in the bays between the horizontal braces. Between the fourth and fifth anchorages there are additional horizontal braces between the pairs of cross braces. The corner columns are of square section, nearly 14in., up to the last anchorage at the cliff edge, thereafter diminishing to 10in. The diagonals are 6in. by 10in., the largre dimension being horizontal to reduce wind pressure. The horizontal braces are 10in. by 8in. The corner columns are reinforced with four rods of about ⅝in. diameter at the base, increasing to nearly 1in. at the last anchorage, and thereafter diminishing to about ⅞in. The shear reinforcement is of rods one-third inch and less, spaced about 8in. apart. The reinforcement rods of the diagonals are round about ⅝in. The foundation is formed of inverted tees giving about 72 square feet base on a layer of rich concrete which rests on compact limestone rock. Raking struts, which are in line with the corners of the somewhat bell-shaped shelter or waiting room at the base of the tower, have separate foundations.

The continuations of the pairs of horizontal braces are carried into the cliff to form the anchorages, and there is cross bracing between the tower and the cliff at these points. The lower of these anchorages are intended only to give stability and to prevent any tendency to buckling under the vertical load; they are tipped with a reverse taper concreted into the rock to a depth of about 20in. The two upper anchorages, on which depends resistance to the swaying of the tower in the wind, are anchored more deeply, about 24in., and each in four places, for besides the continuations of the horizontal braces there are two struts raked in plan, which give a wide spacing for the development of a moment of resistance of the anchorage cantilever when opposed to the moment caused by a wind blowing along the face of the cliff. The volume of reinforced concrete, including foundations, is about 1230 cubic feet, the tower itself accounting for about 910 cubic feet.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

COCHRAN AND CO., ANNAN, Limited, inform us that their Glasgow office is now in charge of Mr. P. S. Drew, 256, Darnley-street, Pollokshields, Glasgow.

AT a meeting of the board of directors of the Independent Pneumatic Tool Company, held recently in Chicago, Mr. Gordon H. McCrae, manager of the company's London office, was elected vice-president.

A COMPANY has been established at Melrose-street, Scarborough, for the manufacture of the Baker oil separator. It is styled the Baker Oil Separator Company, and Mr. John Baker, the patentee of the separator, is at its head.

WE are informed by Messrs. John Cashmore, of Great Bridge, Staffs., that they have purchased the works of Cochran and Co. (Woodside), Dudley, and will dismantle and break up part of the plant, but should trade improve it is thought that portions of the works may be re-started.

WE are informed that Mr. James Horne has just retired from active service with Vickers Limited. He joined the Barrow factory in August, 1898, as chief hydraulic engineer to the company, and his special work has been the designing of heavy gun mountings and accessory mechanisms. We understand that Mr. Horne will still retain a connection with the company in an advisory capacity.

WE are informed that for several years past some large British manufacturing concerns have been interested in the production of ingot iron of "Armco" specification and quality. Among these, developments have recently taken place to manufacture on a big scale all grades of "Armco" ingot iron in Great Britain, and with this object in view the Armco International Corporation has opened offices at Pinner's Hall, Old Broad-street, London, E.C. 2, and has secured the services of Captain Reginald Terrell as managing director. Under the present arrangement ingot iron will be manufactured for the Armco International Corporation by both the Shelton Iron, Steel and Coal Company, Limited, of Stoke-on-Trent, and the Scottish Iron and Steel Company, Limited, of Glasgow. Tubes and pipes will be made of "Armco" ingot iron by the Scottish Tube Company, Limited, of Glasgow, and the Whitecross Company, Limited, of Warrington, will draw the pure iron product into wire and welding electrodes. In this way it is hoped that the entire British market for plates, sheets, sections, angles, bars, tubes and wire of "Armco" ingot iron will be served by British manufacturers throughout.

CONTRACTS.

JOSEPH KAYE AND SONS, Limited, Lock Works, Leeds, inform us that they have just received a new contract from the Admiralty for seamless steel serrated valve oil feeders with interchangeable spouts.

THE VICKERS-SPEARING BOILER COMPANY, Limited, 20, Kingsway, London, W.C. 2, has secured a contract for two 25,000 lb. water-tube boilers fitted with cast iron economisers, superheaters, &c.; also the complete building extensions for the County Borough of Southport Electricity Department. The boilers will be fitted with "Illinois" patented forced draught chain grate stokers.

WE are informed that the Madras and Southern Mahratta Railway has placed an order with Powell-Brett, Limited, of Coventry, for drop-stamped steel wheel centres, 3ft. 2in. in diameter, and that the North-Western Railway of India has ordered from the same makers smaller wheels stamped complete with tires. In both cases the Powell-Brett panelled disc centres, described in THE ENGINEER of July 18th, 1924, were specified.

DANIEL ADAMSON AND CO., Limited, of Dukinfield, near Manchester, has received an order from the Dartford Rural District Council for two sets of their latest improved Adamsonia "Tandem" type of pneumatic sewage lifting ejectors as adopted by the Royal Air Force for Cairo. This plant is for use in connection with the Stone and Swanscombe sewerage scheme. As this is an isolated installation away from any electric supply, the question of compressing the air for the ejectors automatically is interesting. Constant supervision in the compressor house would have made the cost very heavy, and to obviate it the Adamsonia fully automatic switch, internal combustion engine driven, air compressing plant, will be installed.

LAUNCHES AND TRIAL TRIPS.

JAMES DUNFORD, self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Dunford Steamship Company, Limited; dimensions, 235ft. by 36ft. by 16ft. 1in.; 1500 tons deadweight. Engines, triple-expansion, pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; trial trip, August 19th.

SENTRY, single-screw cargo steamer; built by Tyne Iron Shipbuilding Company, Limited, to the order of Fisher-Renwick Manchester-London Steamers, Limited; dimensions, 230ft. by 35ft. by 24ft.; 1600 tons deadweight. Engines, triple-expansion, 18in., 30in. and 49in. by 33in. stroke, pressure 180 lb.; trial trip, August 25th.

BRULIN, single-screw steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of Wm. Crawford and Co., of Montreal; 3500 tons deadweight. Engines, triple-expansion; trial trip, August 29th.

PADDLE STEAMER; built by J. I. Thornycroft and Co., Limited, to the order of the Southern Railway Company; dimensions, 190ft. by 26ft. by 9ft. Engines, compound diagonal surface condensing, 27in., 51in. by 54in. stroke, pressure 130 lb.; constructed by D. and W. Henderson; trial trip, August 29th.

"T.I.C. SCREW KEEL No. 4," mooring craft; built by Palmers' Shipbuilding and Iron Company, Limited, to the order of the Tyne Improvement Commission; dimensions, 111ft. 6in. by 30ft. by 11ft. 6in. Engines, compound inverted reciprocating type; constructed by the Shields Engineering Company, Limited; launch, September 1st.

JAMNAGAR, single-screw steamer; built by J. I. Thornycroft and Co., Limited, to the order of the Maharajah Jam Sahib of Nawanagar; dimensions, 160ft. 4¼in. by 26ft. by 12ft. 6in.; 665 tons deadweight. Engines, triple-expansion, surface condensing, direct acting, 13¼in., 22in., 35in. by 27in. stroke, pressure 180 lb.; constructed by the builders; launch, September 2nd.

LIGER, hopper dredger; built by Wm. Simons and Co., Limited, to the order of the Anglo-Persian Oil Company. Engines, triple-expansion, surface condensing; constructed by the builders; launch, September 2nd.

COMLIEBANK, twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of the Bank Line, Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5210 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; launch, September 3rd.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c. i. f.)	22/-

PIG IRON.

	Home. £ s. d	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 16 3	—
No. 1 Foundry	4 18 9	—
No. 3 Foundry	4 13 9	—
N.E. COAST—		
Hematite Mixed Nos.	4 11 9	4 11 0
No. 1	4 11 6	4 11 6
Cleveland—		
No. 1	4 7 6	4 7 6
Silicious Iron	4 7 6	4 7 6
No. 3 G.M.B.	4 2 0	4 2 0
No. 4 Foundry	4 1 0	4 1 0
No. 4 Forge	4 0 0	4 0 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 2 0	—
„ „ Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 2 6	
„ Forge	3 17 0	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0 to 4 6 9	
Forge	4 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	—
No. 4 Forge	4 12 6 to 4 15 0	—
Basic	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 10 0 (a) / 5 15 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ¾in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 15 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lanca. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basic	9 0 0	
Soft Basic	8 5 0 to 8 10 0	
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	9 7 6 to 10 0 0	
Billets and Sheet-bars	7 10 0 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 10 0 to 10 0 0	
Joists	9 10 0 to 10 0 0	
Tees	10 10 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/6
Block Tin (cash)	260 15 0
„ (three months)	261 10 0
Copper (cash)	63 2 6
„ (three months)	64 2 6
Spanish Lead (cash)	33 1 3
„ (three months)	32 3 9
Spelter (cash)	33 1 3
„ (three months)	33 15 0
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
„ Electrolytic	70 0 0
„ Strong Sheets	94 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	35 5 0
„ Foreign	34 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£14 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£64 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 2 6 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 6/- per unit	
„ Vanadium	18/9 per lb.	
„ Molybdenum	8/2 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/9 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	18/9
„ „ Ell	20/-
„ „ Splint	22/- to 24/6
„ „ Trebles	22/6
„ „ Doubles	18/9
„ „ Singles	15/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	18/9
„ „ Splint	22/-
„ „ Trebles	22/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	16/- to 20/3
Screened Navigation	26/-
Trebles	24/-
Doubles	18/3
Singles	15/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	18/3
Secondary Steam	17/3
Trebles	23/3
Doubles	18/9
Singles	15/9

ENGLAND.

(8) N.W. COAST—	
Steams	28/6
Household	45/- to 58/4
Coke	33/6
NORTHUMBERLAND—	
Best Steams	19/- to 20/6
Second Steams	18/-
Steam Smalls	10/6
Unscreened	16/- to 17/-
Household	23/6 to 25/-
DURHAM—	
Best Gas	21/6 to 22/6
Second	18/- to 18/6
Household	23/6 to 25/-
Foundry Coke	26/- to 26/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	26/- to 28/- —
„ „ House	23/- to 25/- —
„ „ Large Nuts	21/- to 25/- —
„ „ Small „	16/- to 17/6 —
Yorkshire Hards	21/6 to 22/6 —
Derbyshire „	21/- to 22/- —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/- to 14/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 26/- to 27/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/- to 29/-
Second „ „	27/- to 28/-
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	26/- to 26/6
Western Valley „	25/6 to 26/-
Best Eastern Valley Large	25/- to 25/6
Ordinary „ „	24/- to 25/-
Best Steam Smalls	17/- to 17/6
Ordinary „	14/6 to 16/6
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	27/- to 28/-
„ „ Smalls	20/- to 22/-
No. 2 „ Large	23/- to 24/-
„ „ Through	19/- to 21/-
„ „ Smalls	14/- to 15/-
Foundry Coke (export)	45/- to 52/6
Furnace Coke (export)	32/- to 35/-
Patent Fuel	27/- to 29/-
Pitwood (ex ship)	29/- to 30/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	52/6 to 55/-
Seconds	45/- to 47/6
Red Vein	33/- to 35/-
Machine-made Cobbles	57/6 to 60/-
Nuts	55/- to 62/6
Beans	40/- to 42/6
Peas	24/- to 27/-
Breaker Duff	11/- to 11/6
Rubbly Culm	12/6 to 13/-
Steam Coals:	
Large	23/- to 24/-
Seconds	22/- to 23/-
Smalls	14/- to 18/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 21/- to 25/-; open market, round about 24/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

ALL through the long period of business inactivity some departments of the engineering trades, such as the structural, have never suffered from an acute depression, but others have rarely experienced such hard times, and the only thing that prevented a real crisis was the belief that the situation would improve rapidly with a settlement of the reparations problem. A crisis would inevitably have ensued if a lack of work had put a considerable number of men out of employment, but as labour is normally insufficient and has to be supplied largely by the importation of foreigners, the slowing down of production is not particularly noticeable. There has, nevertheless, been many company reconstructions, reductions of capital and reorganisations in order to tide over the present difficult period. If work is being held up largely on account of the instability of raw material prices, there is, unfortunately, nothing yet to show that the situation will shortly improve. After a revival of hope that something would come out of the conferences in London and Geneva, confidence is certainly waning this week in an early settlement of the questions that affect the trade situation. There is a real fear that matters will become complicated unless a satisfactory arrangement is come to with Germany before that country is able to impose what duties it pleases upon goods from France and particularly from Alsace-Lorraine, and as Germany is believed to refuse to carry through any treaty of commerce until the Ruhr is completely evacuated it may be a long time before any solid element of recovery can be anticipated. German competition has taken an unexpected form in the partial confirmation this week of the report that the French Government has placed some extensive orders in Germany for railway rolling stock on account of reparations. A little while ago the French Government denied that any new orders had been given out, but it is affirmed that locomotives and wagons are to be supplied by Germany under an arrangement which was entered into a long time ago with that country and has remained so far in abeyance. The statement that Germany is to supply rolling stock is having a disastrous effect upon the French locomotive and wagon builders, who have for two years past been almost destitute of orders.

Road Preservation.

One of the causes of the rapid wear and tear of the roads in Paris is alleged to be the jolting of the motor omnibuses and other heavy vehicles. The destruction, of course, accelerates with the increased jolting due to the wear, and the Municipal Council is anxious to discover some means of attenuating the effects, which are imposing an increasingly heavy charge upon road maintenance. It is hoped that a solution will be found in the fitting of motor omnibuses with pneumatic tires, and a number of vehicles running on such tires have been in service for some months, but it has yet to be seen whether their general adoption will be justified by the cost, as well as by the necessity of eliminating anything that may introduce an element of irregularity into the service. Meanwhile the Paris Municipal Council has decided to organise a competition of devices for absorbing shocks on vehicles weighing 2 tons and more with load. Competitors should be able to present vehicles fitted with their apparatus at any time required after October 1st next. The date of the trials will then be fixed and they will be closed on March 31st, 1925. Apparently each device will be tested separately. Prizes amounting to 50,000*f.* will be distributed for apparatus giving the most satisfactory results. Entries can be sent to the Secretariat de la Direction des Travaux de Paris, 98, Quai de la Rapee, Paris.

Road Construction.

A sum of 560 million francs is to be devoted to street paving in Paris during a period of ten years, and with a view to ensuring the greatest possible economy a considerable amount of experimental work is being carried out with different methods of road construction. The system of paving employed is, of course, determined by local conditions, and if the area devoted to granite setts is reduced, although still occupying more than half of the total, it is possible that granite paving will make more headway if the results being obtained with the mosaic paving—that is to say, the placing of small setts fan shaped—are confirmed by longer experience. The mosaic method of stone paving is very largely employed in the North of France and in Belgium. It has the advantage of being much more silent than the big setts, as the wheels do not jolt over the joints. Wood and asphalt are to be employed over a more extensive area because nothing better has yet been found; but although the programme provides for the use of definite materials, it is yet liable to be modified as the result of tests carried out with various road surfaces, and the experiments with concrete are being followed with particular interest by Paris municipal engineers.

A Historic Lock.

The foundations of the first canal lock constructed in this country were brought to light recently in a public garden at Vierzon, where an arm of the river Yèvre was being drained. The remains of the stone and wood construction, having a width of 4.50 m., were identified as the lock built by Leonardo da Vinci, who was entrusted by Francois 1er with the task of solving the problem of bringing boats laden with salt from Nantes to the royal city of Bourges by the Loire and Cher. The boats could not proceed farther than the Yèvre tributary, and Leonardo da Vinci overcame the difficulty by constructing a lock.

Iron and Steel Production.

According to the returns of the Comité des Forges, the number of furnaces in blast on August 1st last was 133, or two less than in the previous month. The production of pig iron in July totalled 636,168 tons, a decline of 2705 tons as compared with June and of 46,211 tons as compared with the output in May. The total quantity of raw steel produced in July was 564,876 tons. This was an increase on June of 9955 tons and a diminution as compared with May of 33,551 tons. The production in May reached the highest total yet recorded.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

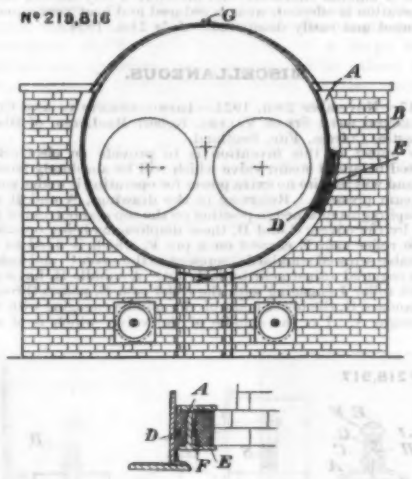
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

219,816. July 31st, 1923.—IMPROVEMENTS IN EXPANSION JOINTS FOR STEAM BOILERS, Robert Whitehead, of Limside-road, Hollinwood, Oldham.

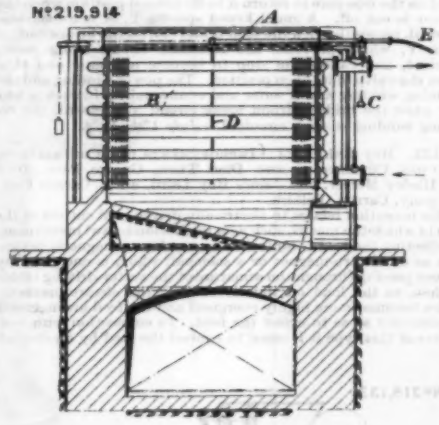
The object of this invention is to provide an improved form of expansion joint for the front end of boilers, particularly Lancashire boilers. Lengths of H section iron A, suitably arched, are mounted between the boiler and the brick-



work B, at the front end of the boiler, each length extending from the usual saddle part of the brickwork to a point on a level with or above the side flue. Within each channel of the H iron is a mat or packing of asbestos D E. A metal hoop encircles the boiler and holds the H sections and packing firmly against the boiler, the ends of the hoop being connected together at G.—*August* 7th, 1924.

219,914. August 18th, 1923.—IMPROVEMENTS IN AND RELATING TO ECONOMISERS OR FEED-WATER HEATERS, Heinrich Föge, of Nicolaistrasse 44, Hanover, Germany.

A cleaning device for cleaning the tubes of economisers is described in this specification. The device consists of a transverse tube A, which is mounted on rollers or slides, so that

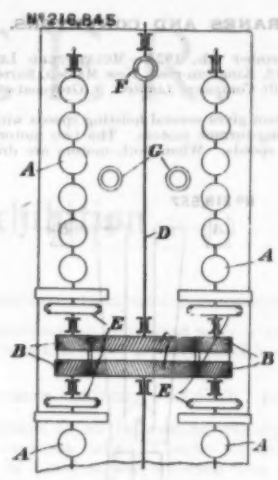


it can move along in the longitudinal direction of the bank of tubes B. The displacement may be brought about by means of a wire rope provided with a handle C. Blowing pipes D are suspended from the pipe A. Steam or air is supplied to this cleaning apparatus through a flexible pipe E.—*August 7th*, 1924.

INTERNAL COMBUSTION ENGINES.

216,845. April 10th, 1924.—IMPROVEMENTS IN OR RELATING TO INTERNAL COMBUSTION ENGINE POWER PLANTS USING OIL AS FUEL, Otto August Banner, of 2703, Highland Boulevard, Milwaukee, Wisconsin, U.S.A.

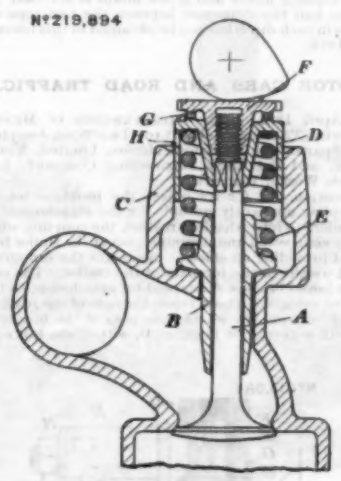
This invention relates to the control of multiple engine units transmitting power to a central driven shaft. The plant described in the specification consists of four six-cylinder oil engines A, which are geared through pinions B and gear wheels to a main shaft D, elastic couplings E being interposed between the engines and the pinions. A main governor F driven from the centre shaft serves to control the fuel supply with respect to the speed, and the load under which the plant is working, the governor coming into operation when a certain speed of the main shaft has been reached. In addition to the main governor F, special governors G, which may be either of the emergency or maximum speed type are fitted to each engine. In the case of a ship, should the propeller suddenly emerge from the water the maximum speed governors of all the engines would act independently of each other. If a coupling between the engine and the pinion should break, then the governor G will prevent the engine racing. Thus the speed of the engine which has been released by the breaking of the coupling will be limited to about normal, while the other three engines will continue to transmit power undisturbed. In a marine installation it



is claimed that the stopping of the propelling machinery is avoided, and any danger arising from this source is thereby avoided.—*August 7th*, 1924.

219,894. February 28th, 1924.—IMPROVEMENTS IN OR RELATING TO THE VALVES OF INTERNAL COMBUSTION ENGINES, Noel Banner Newton, of King-street West, Manchester.

This invention relates to improved means for adjusting the valves of internal combustion engines, and also of providing additional guiding support for the tappet end of the valve. As will be seen from the accompanying illustration, the valve A is provided with a bottom bush B which fits within the valve casing C. At the top of the valve a portion of the stem is squared and carries the piston-like guide D. The valve spring E takes up its position between bush B and guide D. The

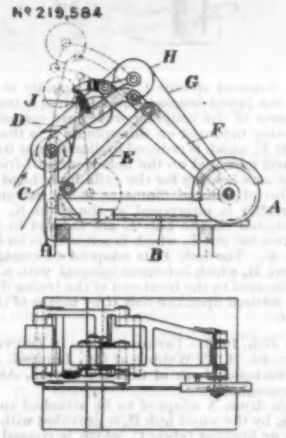


centre of the guide is conical and is made to coincide with a coned nut F, which is carried on the screwed end of the valve spindle. On the under face of the nut and also on the upper face of the guide V-shaped teeth G are formed. The rim of the nut is notched to take a key, and a small hole H is drilled in the side of the guide so that it can be held while the nut F is turned. When the clearance between the valve and its operating cam requires to be reduced or increased, the necessary adjustment can be effected by merely partially rotating the nut F. The tension of the spring and the V teeth serve to hold the nut locked after the adjustment has been made.—*August 7th* 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

219,584. December 29th, 1923.—A STRAIGHT LINE MOTION, L. Bloch, 50, Faubourgh de Pierres, Strassbourg, France.

This mechanism is said to provide a straight line motion for a



tool, such as the circular saw A, as it is moved horizontally across the piece of work B. It comprises a fixed bracket C, to which there are pivoted the two links D and E. The opposite ends of

these links are attached to the frame F, which carries the saw. The driving belt for the saw G passes over two jockey pulleys, one of which, H, is controlled by a spring J.—*July 31st*, 1924.

CRANES AND CONVEYORS.

219,557. November 6th, 1923.—MULTI-SPEED LIFTS, W. J. Huggett, 12, Kingston-road, New Malden, Surrey, and The Express Lift Company, Limited, 9, Greycoat-street, Westminster.

This lift system gives several hoisting speeds with constant-speed alternating-current motors. The two motors A and B have different speeds. When both motors are driven in the

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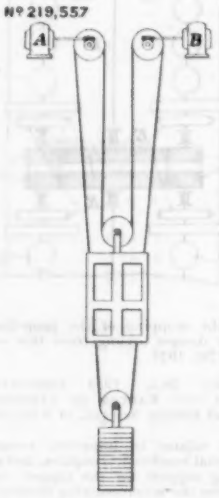


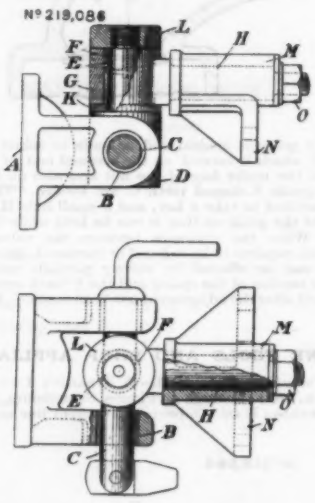
lifting or lowering direction the speed of the car and of the balance weight is equal to half the sum of the two rope speeds. If one motor is stopped the car speed is one half the rope speed due to the running motor and if one motor is reversed the car speed is one half the difference between the two rope speeds. Four speeds in each direction can be obtained in this manner.—*July 31st*, 1924.

MOTOR CARS AND ROAD TRAFFIC.

219,086. April 18th, 1923.—IMPROVEMENTS IN MEANS FOR ATTACHING TRAILERS TO HAULAGE TRACTORS, Joseph James Knox Sparrow, of Knutsford Motors, Limited, Knutsford, Chester, and the Eagle Engineering Company, Limited, of Eagle Works, Warwick.

This invention has for its object the provision of an improved coupling eminently suitable for the attachment of two-wheeled trailers to four-wheeled tractors, the coupling admitting of the ready connection and disconnection of the trailer from the tractor, and providing an efficient means for the support of the unbalanced weight of the forepart of the trailer. The coupling comprises a jawed bracket A adapted for attachment to the rear of the tractor vehicle at a part below the axle of the road wheels, and midway between the wheels, the jaws of the bracket being provided with anti-friction bearings B, within which is mounted

Nº 219,086

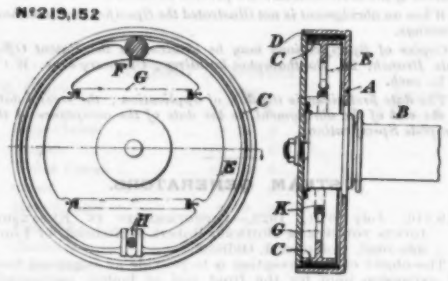


a horizontally disposed spindle C. This spindle is readily removable from the jawed bracket A, and forms a trunnion support for the parts of the coupling which are connected to the trailer. Rotatably mounted on this spindle C is the cylindrical head D of a bolt E, which is reduced in diameter at its upper end and screwed, and mounted on the bolt is an anti-friction sleeve F, which serves as a bearing for the cylindrical head G of a bolt H, which is also of reduced diameter at its extremity and is screwed. A washer is interposed at the point K. The parts referred to mounted on the bolt E are secured in position by means of the knurled nut L, which is screwed on to and secured upon the bolt E. The bolt H is adapted to engage within a cylindrical sleeve M, which is formed integral with a bracket N, adapted to be secured to the front end of the trailer drawbar, the sleeve M being secured upon the bolt H by means of the nut O.—*July 18th*, 1924.

219,152. June 27th, 1923.—IMPROVEMENTS IN FRICTION BRAKES FOR VEHICLES, H. C. Webb and Co., Limited, and George Leonard Atkinson, both of Century Works, Aston Brook-street, Birmingham.

The rotatable drum A adapted to be attached to the wheel, as, for instance, by the wheel hub B, is provided with an annular band of lining or braking fabric C, which is riveted in position to the inner face of the wall D. The brake shoes E are adapted to operate in the usual manner from a pivot F against the action of springs G, by means of rotatable mechanism H, and their outer braking faces are of plain metal and adapted to make contact with the lining or braking fabric C. A stationary plate may be accommodated within the wall D in close proximity to the lining or brake fabric C, virtually contacting it to form a water-tight joint. The brake shoes E are pivoted at F on the fixed plate, and the drum A D is adapted to rotate with the wheel. If desired, the drum may be of a stationary character,

Nº 219,152



and the internal expanding mechanism may be adapted to rotate with the wheel. The lining or braking fabric is of an endless or annular character, and therefore a very smooth braking operation is effected, wear is reduced and heat very equally distributed and easily dissipated.—*July 24th*, 1924.

MISCELLANEOUS.

218,917. November 29th, 1923.—IMPROVEMENTS IN AND CONNECTED WITH STEAM VALVES, Robert MacLaren, of Blaircastle, Culross, Fife, Scotland.

The object of this invention is to provide an electrically operated balanced steam valve which will be absolutely steam-tight and will require no extra power for operating it under varying steam pressure. Referring to the drawings, A and B are the diaphragms retained in position on the top and bottom of the valve by the covers C and D, these diaphragms being operated by the roller cam E carried on a pin F, which is fixed to an adjustable screwed standard G screwed to the cover C, and locked to the required adjustment by lock nut. A spindle H, having a contact roller J engaging with the roller cam E, passes through the standard G, the lower point of the spindle engaging with the diaphragm A. I is the spindle of the valve, which is of the

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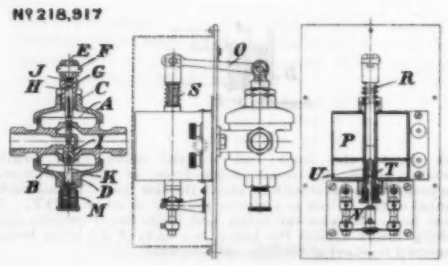
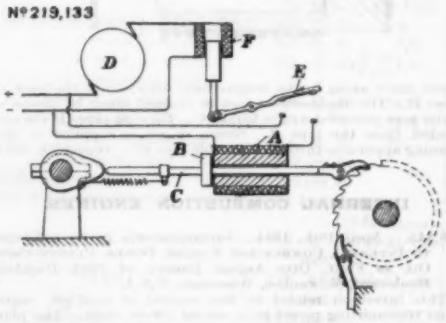


equilibrium type, to which the diaphragms are attached. The lower end of the valve spindle I bears against a plunger K, carried on the bottom valve cover D, on which a spiral spring M is fitted and is made to press the valves towards their seats, an adjusting cap being provided for tensioning the spring. The valve is connected to a solenoid P by a lever O. The iron core R passes through one of the solenoids P, a spring S being provided on the iron core to return it to its normal position when the current is cut off. A small keyed spindle T, of non-magnetic material, passes through the stop U and carries the bridge carbon break V, which prevents the retaining circuit being short-circuited, and causes the stop to become magnetic and thus retain the valve in its open position. The power winding and the retaining winding are in series and connected up in such a way that when the bridge carbon break circuit V is closed, the retaining winding is short circuited.—*July 17th*, 1924.

219,133. May 30th, 1923.—IMPROVEMENTS IN OR RELATING TO COAL CUTTERS OF THE DISC TYPE, George Pate, John Harley Mercer, and James Roy Laird, all of Carron Company, Carron, Falkirk.

This invention relates to electrically driven coal cutters of the type in which the means, such as a ratchet-and-pawl mechanism, for effecting the feed is controlled by an electro-magnetic device, such as an electro-magnet or a solenoid, which is energised by current passing through the armature of the cutter-driving motor so that, as the load on the motor rises the electro-magnetic device becomes more highly energised and the feed arrangement is controlled so as to arrest the feed. In connection with coal cutters of this type it is usual to control the feed by an electro-

Nº 219,133



magnet or solenoid which is in series with the armature of the cutter driving motor. Referring to the drawing, the feed-controlling means comprises an electro-magnet A associated with an armature B formed as a collar on the pawl-actuating rod C, and arranged so that, at the end of each feeding stroke of the rod C, the armature or collar B closely approaches the core of the electro-magnet A. The electro-magnet is in a circuit including the main supply, which is normally interrupted by a contactor E, the solenoid F of which is in series with the armature of the cutter driving motor D. As the load on the motor rises the solenoid F becomes more highly energised, whereby the contactor is closed and the magnet A is energised, thus causing the collar B to adhere to the core and rendering the rod C inoperative.—*July 24th*, 1924.

219,240. December 22nd, 1923.—IMPROVEMENTS IN WASHERS FOR WASHING GRAVEL, SAND OR OTHER SIMILAR MATERIAL, Joseph Southall, of the Worcester Foundry, Foundry-street, Worcester.

The continuous projecting propelling member of the revolving barrel is in the form of an internal spiral blade. A is the revolving barrel, B the internal spiral blade, C the charging hopper, D the water inlet pipe at the opposite end of the barrel, and E a discharge chute. The spiral blade B gradually increases in height from the charge end of the barrel to the discharge end.

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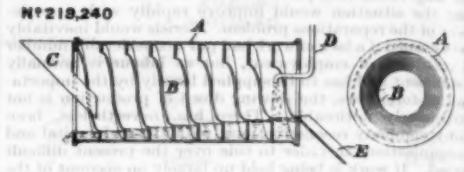

During the operation of the machine the material from the hopper C is continuously propelled through the revolving barrel by the spiral blade B in a direction towards the discharge chute E, and in opposition to the flow of water through the barrel, whilst the gradual increase in height of the spiral blade B from the charge end of the barrel to the discharge end has the effect of ensuring a continuous flow of water towards the charge end of the barrel, over the gradually lowering rim of the blade, thereby entirely preventing any possibility of dirty water flowing towards or accumulating at the discharge end of the barrel. A modification of the invention is described.—*July 24th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

FRIDAY TO SATURDAY, SEPTEMBER 5TH TO 27TH.

MACHINE TOOL AND ENGINEERING EXHIBITION.—At Olympia. 10.30 a.m. (10 a.m. Saturdays).

SATURDAY, SEPTEMBER 13TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Public Library, Graham-road, Great Malvern. West Midland District meeting. 11.30 a.m.

MONDAY, SEPTEMBER 15TH.

BRITISH EMPIRE EXHIBITION.—Conference Hall No. 3. Conference of Engineering Societies. Papers: "The Working of Stainless Steel," by Miss C. Griff; "Co-operation between the Works Chemist and the Engineer," by Mr. A. R. Page; "Ceylon Plumbago—its Uses and High Qualities," by Mr. T. G. Hunter; "Technical Popular Fallacies," by Mr. A. S. E. Ackermann. 10.30 a.m.

TUESDAY AND WEDNESDAY, SEPTEMBER 16TH AND 17TH.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS AND SUPERINTENDENTS. Annual meeting in Glasgow. For programme see page 181.

THURSDAY, SEPTEMBER 18TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Mansfield. East Midland District meeting. 10.30 a.m.

FRIDAY, SEPTEMBER 19TH.

INSTITUTE OF TRANSPORT.—British Empire Exhibition, Wembley. Conference. Papers: "Imperial Communications," by Air Vice-Marshal Sir Sefton Brancker; and "Transportation in relation to the Development of South Africa," by Mr. F. B. Rees. 10.15 a.m.

SATURDAY, SEPTEMBER 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Wallasey. North-Western District meeting. 11 a.m.

TUESDAY, SEPTEMBER 23RD.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. "An Engineer's Life in Eastern Oilfields," by Mr. E. B. Seymour Norton. 6.30 p.m.

THURSDAY, SEPTEMBER 25TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—The Engineers' Club, Coventry-street, London, W. 1. Paper, "The Future of Main Line Electrification on British Railways," by Lieut.-Colonel E. O'Brien. 7 p.m.

SATURDAY, SEPTEMBER 27TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chamber, Town Hall, Gosport. Southern District meeting. 11 a.m.

THURSDAY AND FRIDAY, OCTOBER 2ND AND 3RD.

INSTITUTION OF MINING ENGINEERS.—British Empire Exhibition, Wembley. Thirty-fifth annual general meeting.

COPPER STANDARDS.—The British Engineering Standards Association has recently issued five specifications for different grades of raw copper, namely, No. 199–1924, Electrolytic Copper Ingots and Ingot Bars; No. 200–1924, Tough Copper Cakes and Billets for Rolling; No. 201–1924, Fine Copper Cakes for Rolling; No. 202–1924, Electrolytic Cathode Copper; and No. 203–1924, "Best-Select" Copper. A sixth specification covering electrolytic copper wire bars, cakes, slabs and billets will be published shortly. The aim has been to make the specifications sufficiently exacting to maintain and improve the quality of raw material already being supplied to high purities, and at the same time to leave them elastic enough for ordinary metal market use. Copies of the specifications may be obtained from the B.E.S.A., Publications Department, 28, Victoria-street, Westminster, S.W. 1, price 1s. 2d. each post free.